INTERNATIONAL ABSTRACT OF SURGERY

VOLUME 74 FEBRUARY, 1942 NUMBER 2

TUBERCULOUS EMPYEMA

A Collective Review of the Literature from 1930 to 1941

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WITHIN recent years the treatment of pulmonary tuberculosis has become increasingly the responsibility of surgeons working in collaboration with internists. Tuberculous empyema should be considered at all times a medicosurgical problem. Many cases of tuberculous empyema will never require surgical treatment, but at all times the thoracic surgeon should share with the phthisiologist responsibility for withholding or deferring it.

It is unfortunately impossible to postulate the definite boundary between a simple tuberculous pleural effusion and tuberculous empyema. When does serofibrinous fluid become purulent? How many cells mean pus? What percentage of sediment should be present in fluid to merit the epithet "pus"? These questions cannot be answered categorically, since the patient's reactions and the degree of the physician's concern will contribute to his differential diagnosis between a serofibrinous or seropurulent effusion and empyema.

WHAT IS TUBERCULOUS EMPYEMA?

Definitions offered by contributing authors cover a vast range. Woodruff considers tuberculous empyema to be any turbid pleural fluid in the presence of pulmonary tuberculosis or any pleural fluid containing tubercle bacilli on direct smear. Far to the other extreme, Souto thinks that only localized and well defined pleural pus should be called empyema; he does not include merely purulent pleurisy or seropurulent fluid. Archibald considers as empyema seropurulent and purulent pleural effusions which contain tubercle bacilli even though the bacilli may be detected only by guinea-pig inoculation. Bernou, Fruchaud, and Marécaux do not even require readily demonstrable tubercle bacilli. Bodo stresses the presence of numerous cells and tubercle bacilli. Hedblom has defined tuberculous empyema "as a type of suppurating pleurisy in which the tuberculosis bacillus is either the sole infective organism or is one of the organisms of a mixed infection." Keller also accepts this definition. The Committee on Empyema of the American Sanatorium Association includes in its studies seropurulent and purulent pleural effusions due to the tubercle bacillus alone or together with pyogenic organisms. In his report Smart does not include serous or seropurulent effusions, believing that these are not truly empyematous.

Thinking that the physical and bacteriological aspects of the fluid are not sufficiently characteristic, DeCecio and Potter consider tuberculous empyema to be "a frankly purulent bacillary (tubercle bacilli) fluid, which forms rapidly and similarly tends to reform, characterized clinically by a prolonged fever with frequent remissions and recurrences, and resulting in progressive constitutional decline as chronicity is established. . . ."

Carmichael further circumscribes tuberculous empyema with qualifying phrases by stating, " . . . by purulent fluid is meant definitely thickened fluid remaining as an opaque suspension on standing, without reference to bacterial or cell content, and which in our experience tends to recur promptly following aspiration, to form thoracic wall or bronchial fistulae, to persist and progress to amyloid disease and a fatal termination."

Such widely divergent understandings of the nature of tuberculous empyema make comparisons of therapeutic methods difficult. Better results will be had in treating patients with seropurulent fluid than will be obtained in the treatment of the tragic cases defined by Carmichael.

It is my belief that tuberculous empyema should mean serofibrinous, seropurulent, and purulent pleural effusions due wholly or in part to the tubercle bacillus, and in which tubercle bacilli can be found in smears, cultures, or by animal inoculation. I offer this quite inclusive and certainly wide definition because I believe it is impossible to decide which infected but still serous fluids will subsequently become frankly purulent. Good results will depend upon prompt and adequate treatment of such infected fluids. It is certainly true that even clear effusions all too frequently become empyema. Therefore I think it is best to consider as empyema and treat as empyema all cloudy or turbid pleural fluids that contain tubercle bacilli.

INCIDENCE

Tuberculous empyema most frequently occurs as a complication of artificial pneumothorax used in the treatment of pulmonary tuberculosis. As this method of collapse therapy has become more widely adopted, the incidence of tuberculous empyema has increased. An effusion developing in the course of artificial pneumothorax may be purulent from the onset or it may become purulent over a period of weeks or months. There have been only a few significant reports of large groups of cases of patients with artificial pneumothorax. In 1927 Hayes[1] reported 151 cases of artificial pneumothorax with empyema in 21 per cent. In 1926 Burrell[1] found that 11.6 per cent of 309 cases of induced pneumothorax developed empyema, and in 1924 Matson[1] and his associates reported pleural infection in 12.2 per cent of 420 patients with artificial pneumothorax. Peters and Wooley[1] in 1922 reported an incidence of empyema of only 6 per cent.

While the absolute number of cases of empyema has increased in the past ten years, the percentage complicating artificial pneumothorax has remained about the same—from 10 to 15 per cent: Bacon found 8 cases among 116 patients (6.6 per cent); Brock, Mullen, and Woodson, 129 among 530 (22.4 per cent); Carmichael, 22 among 105 (21 per cent); Jonsson, 80 among 944, (8.5 per cent); Nicklas, Franklin, and Zavod, 54 among 375 (14.4 per cent); Skavlem, 94 among 898 (10.4 per cent); Leaver and Hardaway, 5.8 per cent of 750; and Nalbant reports an incidence of 6.1 per cent. The variations in the reported incidence of empyema in patients with artificial pneumothorax, from 5.8 to 22.4 per cent, are in part due to the authors' varying criteria for the diagnosis of empyema. An aggregation of recent reports totals 4,594 patients with artificial pneumothorax. Of this number 1,590 developed pleural effusions; 30.9 per cent of the effusions were purulent.

Tuberculous empyema in children occurs but infrequently. De Elizalde and Cervini have reported the post-mortem examination of a child eight months of age who had cavernous pulmonary tuberculosis and a large pyopneumothorax on the right side, the pus of which contained tubercle bacilli and pneumococci. Fiore has reported 2 cases of tuberculous empyema, one a child eight months of age and the other two years and eight months old. The younger child died and the other recovered after pleural lavages and autovaccination. Leenhardt and his associates have reported a case of spontaneous tuberculous pyopneumothorax which occurred in a child ten months of age. Their patient died two weeks after external drainage which was necessary because of the large and suffocating pneumothorax. There has been reprinted in the Archives of Pediatrics a case described by Northrup in 1884; this was the history of a two-and-a-half-year-old child who died of pulmonary tuberculosis and right tuberculous empyema.

I shall refer to further cases of tuberculous empyema in children in series reported by Seyffarth and by Waltner. Although such occurrences are rather infrequent, nevertheless the possibility of tuberculous infection must always be considered in any child with empyema. Particularly when the empyema has long persisted, careful search for tuberculosis should be made by bacteriological examination of the pus, guinea-pig inoculation, and bioptic examination of a piece of pleura. Tuberculin tests are of great value in excluding or establishing a diagnosis of tuberculosis.

PATHOGENESIS

The development of tuberculous empyema is, to some extent, dependent upon the development of tuberculous pleural effusions. In general there are two types of pleural effusions, mechanical and inflammatory. Effusions which accompany pneumothorax may be due to: (1) true tuberculous pleuritis, (2) tuberculin reaction without bacillary invasion, (3) transudation, and (4) non-specific pleuritis due to mechanical irritation, injury to the pleura, or chemical irritation by insufflated air or the local anesthetic. Most authors agree that pleural infection with tubercle bacilli is by far the most frequent cause.

Many sources of irritation to the pleura have been cited and some of these irritants are peculiar to artificial pneumothorax. Ghibellini thinks

[1] Weisman, J. I. Am. Rev. Tuberc., 1936, 33: 522.

that among mechanical causes of pleural effusions complicating artificial pneumothorax there should be included: (1) positive intrapleural pressures; (2) menstrual periods; (3) the irritative action of needle puncture; (4) the predominance of sympathetic nerves; (5) a particularly sensitive pleura; (6) an allergic reaction of the pleura; (7) excessively negative intrapleural pressures; (8) the irritant action of the introduced gas; and (9) lymphatic and venous stasis.

Pisani and Smejkal believe that important causes of parapneumothoracic effusions are: (1) increased permeability of the capillaries because of oxygen want; (2) increased osmosis; (3) higher concentration of hydrogen ions; and (4) calcium deficiency of the pleura. To offset these causes and to decrease the occurrence of pleural effusions, Pisani and Smejkal use intramuscular injections of calcium gluconate. They have treated 20 patients with artificial pneumothorax in this fashion and found very small effusions only in 2; in 7 of a control group of 14 patients copious effusions developed.

Whatever diverse theories of the development of parapneumothoracic pleural effusions have been offered, there is no doubt that tuberculous empyema is due entirely to infection of the pleura by the bacillus tuberculosis.

Boquet and Laporte have produced pleural effusions by the intrapleural injection of tubercle bacilli in previously sensitized animals. They have found that inoculation was followed shortly by the invasion by the bacilli of all the organs but particularly of the lungs. In all cases bacillemia was found. Lemon and Montgomery injected suspensions of virulent bovine tubercle bacilli into the right pleural cavity of rabbits. The first reaction was that of a non-specific inflammation. Then the fluid and cellular parts of the resultant effusion were resorbed, phagocytosis took place, and the infected material was deposited in regional lymph nodes. They found purulent effusions only in sensitized animals which had received a very large sensitizing dose of virulent bacilli. The purulent effusion was preceded by a large amount of serosanguineous fluid.

Hultin believes that the pleura reacts in two different ways to tuberculous infection. According to him, miliary tubercles develop if tubercle bacilli are introduced into serous cavities of unsensitized animals. In sensitized animals the same injection causes a serous effusion. Hultin also thinks that pleural effusion depends in part upon the individual's general condition and degree of tubercular sensitivity, and upon the quantity of bacilli that enter the pleural cavity.

Wakamiya has reported results quite different from those of Hultin. Wakamiya injected virulent human tubercle bacilli into the pleural cavities or mediastinum of guinea pigs, some of which had been sensitized by either human bacilli or Calmette-Guérin bacilli. He found that in unsensitized animals exudative pleurisy always occurred, while in sensitized animals effusion did not always develop. Calmette-Guérin bacilli were found to give much greater protection than human bacilli. Blood cultures were positive for tubercle bacilli in 50 per cent of the animals that were unsensitized or that had been sensitized to human bacilli. In animals that had received Calmette-Guérin bacilli before the intrapleural injection of tubercle bacilli, blood cultures were always negative.

This evidence leads directly to the source of infection of the pleura in man.

Mistral has studied pleural reactions in man by means of the thoracoscope and has described the appearance of the pleura in tuberculous empyema. He has found that the pleura is usually diffusely reddened and hyperemic and studded with numerous whitish fibrinous deposits, most of which are like miliary tubercles. Others are conglomerate caseous masses. Large "pyogenic" membranes are found on the lung, the parietal pleura, and the diaphragm. The fluid is yellow and contains numerous small beads which are smaller and less transparent than those of serous exudates. In occasional cases the purulent reaction may be localized in plaques, but in most it is diffuse.

Penington has made post-mortem examinations of 11 cases of tuberculous empyema. In each there was a thick and easily stripped membrane over the visceral pleura. Microscopically the thickening of the visceral pleura extended to the subserous layers. Simmonds and Pagel have reported their findings at the autopsy of a forty-five-year-old male who died of tuberculous meningitis. Miliary tuberculosis was found in the lungs but the tubercles were confined to the periphery of the lungs to a depth of about 1 in. below the visceral pleura. A similar distribution was found along the pulmonary fissures. These authors have produced this same type of corticopleural miliary tuberculosis by the intravenous injection of virulent tubercle bacilli into sensitized rabbits. Steinmeyer has reported a patient with tuberculosis of the lower lobe of the right lung and an infrapulmonary empyema. In the same patient there was infiltration of the left lingula and a left interlobar empyema. Steinmeyer believes that this patient had tuberculosis of the periphery of both lungs and contiguous empyema.

In all but a very occasional case tuberculous empyema, whether primary or a complication of artificial pneumothorax, is caused by extension of infection from a tuberculous focus in the underlying lung. Jepure and Braicu have suggested that pleural infection may result from: (1) ulceration through the visceral pleura of a subpleural caseous focus; (2) caseonodular pleural tuberculosis; (3) the tearing of adhesions; and (4) injury to the lung by thoracentesis.

Boneo thinks that tuberculous empyema may also be the result of extension of infection from tuberculous lymph nodes contiguous to the pleura or that it may be caused by hematogenous dissemination of tubercle bacilli. Very rarely a tuberculous paravertebral abscess may perforate the pleura and cause tuberculous empyema.

It has long been known that tuberculous pulmonary cavities may rupture into the pleural cavity and cause tuberculous empyema and many such cases have been reported. Those that are reported usually have occurred in a dramatic fashion that makes the diagnosis obvious and the case of interest.

BRONCHOPLEURAL FISTULA

The mode of development of tuberculous empyema is quite obvious in cases such as that described by Apostolides and Hadjissarantos whose patient developed a spontaneous tension pneumothorax and subsequent empyema. Pleural lavage to cure the empyema caused severe vomicas through the permanently open bronchopleural fistula. It is apparent that the empyema was caused by organisms from pulmonary or bronchial foci of infection which reached the pleural cavity through a perforation of the lung. Again in the case reported by Amat the source of infection of the pleura was a large tuberculous cavity in the middle lobe of the right lung. During a course of treatment by the intracavitary injection of colloidal metals the cavity ruptured into the pleural space, which resulted in a bronchopleural fistula and tuberculous empyema. The pulmonary cavity closed soon after this accident and the empyema was cured by suitable treatment. Laguna has reported the post-mortem findings in a patient with a right artificial pneumothorax. At autopsy she was found to have tuberculous empyema which communicated directly with a large apical pulmonary cavity. Sutherland has reported the interesting clinical findings in a twenty-seven-year-old woman who experienced spontaneous rupture of a lung which was partially collapsed by artificial pneumothorax. The patient developed mixed pyogenic and tuberculous pyopneumothorax. On inspiration the level of the fluid was below the level of the bronchopleural fistula and air was consequently drawn through the fistula into the pleural cavity. In expiration with reduction in the volume of the hemithorax the fluid level rose above the bronchial fistula, and air under increasing pressure was thereby trapped in the pleural cavity. Very frequent aspirations of pus and air were necessary to control the intrapleural pressure and relieve the patient's distressing pressure symptoms. These reports of single cases of bronchopleural fistulas are of clinical interest. In each case the diagnosis is at once apparent and the cause of the tuberculous or mixed infected empyema is quite obviously the communication between the pleural space and pulmonary foci of infection.

Despite the fact that pulmonary sources are to be indicted for infecting the pleura in most cases of tuberculous empyema, nevertheless a clinically apparent bronchopleural or pleuropulmonary fistula may not be present in all cases.

Penington examined at autopsy 15 cases of miliary tuberculosis. In only 1 of these cases was a pleural effusion present although tubercles were found bulging into the pleura in many. In addition, 11 other cases of tuberculous empyema were examined at autopsy and in every case one or more tuberculous foci in the lung were found to have ruptured through the thickened visceral pleura and communicated with the empyema cavity. Although the source of infection is thus obvious, nevertheless fistulas were not apparent before death. This is not due to any lack of perspicacity, however. In many cases a true fistula probably did not exist and in others the pleuropulmonary communication may have been so small as to be undetectable.

Matsuzawa thinks that the detection of a bronchopleural fistula in tuberculous empyema may be made by the following procedures:

1. By manometric determinations of the intrapleural pressure before and after the aspiration of fluid or air. In this test the intrapleural pressure will become more highly negative as air and fluid are removed if there is no communication between the pleural cavity and the bronchus.

2. Methylene blue if injected into the pleural cavity in the presence of a bronchopleural fistula will in many cases eventually appear in the sputum if careful search is made for it.

3. Gas analysis of the pneumothorax air may be done before and after the aspiration of a certain quantity of air from within the pneumothorax space. In the presence of a tuberculous parapneumothoracic effusion the pneumothorax

air generally contains between 9 and 14 per cent of carbon dioxide and less than 0.1 per cent of oxygen. Pneumothorax-gas analysis is diagnostic of a bronchopleural fistula if the carbon dioxide is less than 5 per cent and the oxygen more than 7 per cent, or if the carbon dioxide is more than 9 per cent and the oxygen more than 1 per cent.

Matsuzawa has found that intermittently open bronchial fistulas can be detected only by serial analysis of the pneumothorax air. In this method a sample of air is removed and analyzed for carbon dioxide and oxygen. Then a quantity of air sufficient to reduce the intrapleural pressure at least to minus 24 cm. of water is removed. A second sample of air is removed and analyzed for carbon dioxide and oxygen. In the absence of a bronchopleural fistula both analyzed samples should contain the same amounts of these gases. Significant differences in the amounts of carbon dioxide and oxygen present in the two specimens indicate that a bronchopleural fistula has been opened by the induced highly negative intrapleural pressure. Matsuzawa believes that such fistulas should be considered as intermittently open.

He has examined 100 cases of tuberculous empyema by all these methods. In 44 of this group a bronchopleural fistula could not be diagnosed by any means. Of the remaining 56 cases, 27 had persistently open fistulas and these could be detected equally well by all methods. Twenty-nine were intermittently open and were disclosed only by the combined negative-pressure and gas analysis tests. From this it is apparent that even the most meticulous use of available diagnostic methods will reveal bronchopleural fistulas only in about 50 per cent of cases of empyema. At least it may be said that fistulas are of clinical significance in about this portion of cases of tuberculous empyema. In other series of cases of tuberculous empyema, bronchopleural fistula has been recorded less frequently because less accurate diagnostic methods have been used.

Coryllos has expressed the opinion, "the production of purulent exudate in the pleural cavity, or the change of existing clear effusions to purulent ones, is *always due to the development of pleuro-pulmonary fistulae*." It is his belief that such fistulas are caused by the ulceration of caseating subpleural pulmonary tuberculous foci. In the absence of pneumothorax such subpleural lesions lead to the formation of adhesions which prevent the development of spontaneous pneumothorax and empyema. Of course, the sudden perforation of a large subpleural focus with communication between a bronchus and the pleural cavity will cause spontaneous pneumothorax.

Coryllos distinguishes three pathogenetically and clinically distinct sizes of fistula: punctiform (less than 0.5 mm. in diameter); small (less than 1 mm.); and large (1 to 10 mm. or more). Punctiform fistulas are due to the perforation of small caseating tuberculous foci. The erosions are shallow and consequently only superficial alveoli and small bronchioles communicate with the pleural cavity. Because of the small size of the initial lesion the dangers of infection are slight and pyogenic infection is very rare. Furthermore, the small size of the communication causes only slight modification in the pleural pressures. The diameter of a punctiform fistula is reduced during expiration and increased during inspiration. Thus, air may be sucked into the pleural cavity during inspiration whereas diagnostic dyes will not enter the bronchial tree because the fistula is almost closed in expiration. Fistulas of moderate size are caused by the rupture of larger subpleural caseating foci. Such fistulas are also deeper than the preceding type. The number of infecting bacilli is greater and the resultant fluid is more purulent and richer in organisms. There is an accompanying greater rise in oxygen and a greater drop of carbon dioxide. Pyogenic infection is more likely to occur because the larger and infected bronchi are involved. Large fistulas develop in far advanced tuberculosis in which the pneumothorax is ineffective. Gas analysis shows that the pleural air is almost of the same composition as atmospheric air. Large amounts of oxygen favor the growth of tubercle bacilli.

Coryllos believes that clinical evidence to support the theory of the development of effusions by the formation of bronchial fistulas lies in the constant association of acute symptomatic episodes characterized by chest pain, elevation of temperature, increase of intrapleural pressure, and, most important, modifications of the composition of the pleural air. The smaller the fistula the more transient and less severe are the symptoms. The largest number of these complications arise during the first three or four months of the pneumothorax and especially when collapse is not efficient. They are almost invariably due to the rupture of pleuropulmonary adhesions. The presence of fluid in the chest may close the bronchial fistula and this explains why some patients with large amounts of fluid will have few or no symptoms. Furthermore, efforts to sterilize the empyema by lavage of the pleural cavity in the presence of a bronchial fistula are useless since constant reinfection takes place as long as the fistula remains open. Those reports of cures by means of pleural lavage show that the percentage

of cures is no greater than that by any other method.

Coryllos offers surgical evidence to support his belief. In all cases in which he performed Schede operations bronchial fistulas were always present although sometimes it was necessary to flood the surface of the lung with saline solution in order to demonstrate the presence of a fistula by means of bubbling air. Furthermore, the superior results obtained by thoracoplasty are evidence that this form of collapse has closed the fistula.

The same author has also found that in all cases of tuberculous empyema in which autopsy was done, open or healed fistulas could be demonstrated. In recent cases they opened in caseating pulmonary foci. In older cases they were limited by fibrotic tissue. The pathological physiology of a tuberculous pulmonary cavity and a cavity of tuberculous empyema is similar. When pleuropulmonary fistulas are present the pleural cavity cannot become obliterated because the lung cannot re-expand. Tubercle bacilli grow freely in the pleural fluid because of an adequate supply of oxygen. Highly infected fluid may enter the bronchial tree and produce bronchiogenic spread of the disease. Closure of the fistula stops the entrance of air into the pleural cavity, thus favoring expansion of the lung and obliteration of the pleural cavity. Death of the tubercle bacilli takes place as the oxygen supply becomes less.

Laboratory evidence to support Coryllos' belief is supplied by analysis of the pneumothorax air. For this purpose any gas-analysis apparatus may be used, but Coryllos has designed a portable apparatus which allows accurate determination of the pleural air. In the absence of fluid the air in a pneumothorax contains from 3 to 4 per cent of oxygen and about 6 per cent of carbon dioxide. When straw-colored fluid is present, the oxygen makes up between 1 and 2 per cent, and the carbon dioxide between 6 and 8 per cent. When purulent fluid is present, the oxygen is less than 1 per cent, and the carbon dioxide above 8 per cent. In the presence of a fistula the only variations that can occur in the gas content must be an increase of oxygen and a decrease of carbon dioxide since alveolar air contains 15 per cent oxygen and 6 per cent carbon dioxide. In atmospheric air, oxygen is 20.7 per cent and carbon dioxide 0.03 per cent.

The changes in the pneumothorax air are proportionate to the size of the fistula, and the size of the fistula may be deduced from the relative changes in oxygen and carbon dioxide. Small fistulas may cause slight tuberculous infection of previously uninfected fluid and there will be accompanying slight clinical symptoms. Changes in the chemical composition of the air are similarly slight. Following closure of the fistula, which may be spontaneous, and consequent decrease in the amount of oxygen, tubercle bacilli will disappear from the pleural fluid. In this conception Coryllos finds a logical explanation of the slight and transient complications which often develop in the course of pneumothorax.

Ornstein and Ulmar think that the continued presence of tubercle bacilli in a parapneumothoracic effusion or empyema is conclusive evidence of the existence of a bronchopleural fistula. This, they believe, is because tubercle bacilli require a high concentration of oxygen for their growth and a sufficient supply could be provided only through a bronchopleural fistula.

Harpöth and Gad believe that bronchopleural fistulas in a pneumothorax may be diagnosed by gas analysis of the pneumothorax air but that only a comparison of several samples is significant. Although an oxygen content of more than 2 per cent indicates an open pneumothorax, nevertheless a lower oxygen percentage does not necessarily mean that there is no pleuropulmonary communication. When the pleural envelope is intact, Harpöth and Gad think that the relative percentages of oxygen and carbon dioxide in several specimens of pneumothorax air will be almost constant in each patient. Differences in these concentrations in two successive samples of pneumothorax air are diagnostic of a bronchopleural fistula.

Although the opinion of Coryllos that bronchopleural fistula is present in every case of tuberculous empyema may seem rather overstated because of the smaller numbers of fistulas reported in other series of cases, nevertheless this opinion is supported by the reports of Penington and of Ornstein and Ulmar, who have found bronchopleural fistulas in almost all cases of tuberculous empyema examined at autopsy. A more careful search for bronchopleural fistulas and the use of sensitive laboratory tests undoubtedly will disclose greater numbers of fistulas than have hitherto been reported.

It is true that in reports of series of cases of tuberculous empyema not all patients have been found to have bronchopleural fistulas. Of Woodruff's group of 154 patients with tuberculous empyema, 47 had persistent bronchopleural fistulas (30 per cent); however, this figure does not exclude pulmonary rupture as the source of pleural infection. The fistula may have closed soon after it first appeared. Skavlem, Phelps,

Baker, and Christiansen have reported 112 cases of empyema with only 23 revealing a bronchopleural fistula (20.5 per cent). Rosenblatt found a bronchopleural fistula in 5 of 21 cases (24 per cent), and MacDonald in 9 of 15 cases (60 per cent) of tuberculous empyema with mixed pyogenic infection. Nicklas and his associates have reported 54 cases of tuberculous empyema; bronchopleural fistula was diagnosed in 19 (35.1 per cent) and was present in all cases with mixed pyogenic and tuberculous empyema. Jonsson has found that fistulas occurred in 18 of 80 patients with parapneumothoracic empyema (22.5 per cent). It must be pointed out that in most instances in the series of cases just cited, gas analysis had not been used for the diagnosis of bronchopleural fistula.

Very occasionally a clinically apparent bronchopleural fistula may seem to be relatively innocuous to the patient. Gabe has reported the case of a patient with tuberculous empyema and a bronchopleural fistula. For nine years this patient continued to raise small amounts of pus which came from the pleural cavity and during this time only tubercle bacilli could be found in the sputum and pleural pus. Eventually he developed a tuberculous spread to the opposite lung. DeMichelis has reported a rather similar case; in his patient a pleural effusion formed in a loculated pneumothorax pocket. The fluid eventually became caseous and desiccated. Some years later the patient developed a bronchopleural fistula and died with widespread bronchial dissemination of tuberculosis. These cases should underline the dangers that beset every patient with a bronchopleural fistula and emphasize the importance of devoting every effort to effect an early closure of the fistula.

VISCEROPARIETAL ADHESIONS IN ARTIFICIAL PNEUMOTHORAX

Closely related to the development of pleuropulmonary perforations are the visceroparietal adhesions that so often exist and frequently render an artificial pneumothorax not only useless in controlling the pulmonary tuberculosis for which it has been induced, but also distinctly dangerous to the future welfare of the patient. Parapneumothoracic effusions are more frequent when pleural adhesions are present than when free unadherent collapse of the lung has been obtained.

Michetti has studied 200 patients with pneumothorax (bilateral in 17) and has found that adhesions were present in 191 of the 217 pneumothoraces (88 per cent). Of the 191 pneumothoraces with adhesions, 91 (48 per cent) had or had had effusions; of the 26 cases without adhesions only 11.5 per cent had had transient effusions. One hundred cases were studied through the thoracoscope. In 16 the visceral and parietal pleural layers were normal. In 15 the parietal pleura was normal; the visceral pleura was hyperemic in 11 and covered with a fibrous exudate in 4. In 15 both layers were hyperemic. In 6 an acute pleurisy involved both layers. In most of the cases which were observed before six months of pneumothorax, pleuritis was strictly localized around the adhesions. In only 5 of 84 cases were the pleural lesions some distance from the adhesions. Therefore it is thought that the presence of adhesions is the preponderant cause of pleural irritation. Of 94 pleurisies, 66 (70.2 per cent) occurred in the first six months of the pneumothorax and 47 (50 per cent) occurred in the first three months. Michetti concludes that the adhesions should be divided as soon as possible, since thoracoscopy and cautery of the adhesions will be less dangerous and will be better borne by the patient when the pleura is still healthy or but slightly hyperemic.

Mistral believes that parapneumothoracic tuberculous empyema occurs twice as frequently with partial collapse of the lung as with total collapse. He therefore urges that all adhesions should be completely divided early or, if this is impossible, that the pneumothorax should be abandoned and other collapse-therapy measures used.

Sayago and Lastra have found that the type of pulmonary collapse is of importance in the development of pure and mixed infected tuberculous parapneumothoracic empyema since rupture of caseous foci of infection is more likely to occur when the lung is incompletely collapsed because of the presence of visceroparietal adhesions. They found that 80 per cent of 68 cases of tuberculous empyema occurred in patients with pneumothorax that had produced only partial collapse of the lung because of visceroparietal adhesions.

Keers believes that tuberculous parapneumothoracic empyema is caused by the rupture of a visceroparietal pleural adhesion which exposes the pleural cavity to caseous material from a subpleural focus of infection. He thinks further that high intrapleural pressure in a pneumothorax should not be used in the presence of adhesions since they may thereby be ruptured.

Further evidence might be adduced to support this belief that the most important single cause of parapneumothoracic tuberculous empyema is the development of a bronchopleural fistula of greater or lesser size. The information offered by

the authors whose beliefs have been cited should be convincing, however. The common factor that immediately precedes the development of a bronchopleural fistula is often the presence of visceroparietal adhesions that prevent complete collapse of the lung and threaten the patient with tuberculous empyema. It should be remembered that adhesions develop only at sites of inflammation and that foci of infection that cause adherence of the pleural layers must necessarily be dangerously near the pleural surface of the lung.

For these reasons it is important that significant visceroparietal adhesions in a pneumothorax should be cut in order that this menace to the patient's future health shall be removed. If the adhesions cannot be cut then the pneumothorax should be abandoned since the slight clinical improvement that an ineffective pneumothorax offers is greatly outweighed by the threat it offers. The earlier the adhesions are cut, the better it will be. Watchful waiting in the hope that the adhesions will stretch and allow an uncollapsed cavity to close is a dangerous sort of conservatism that is all too frequently practiced by some phthisiologists who are not well enough aware of the mode of development of tuberculous empyema.

Thoracoscopy for the division of visceroparietal adhesions in an induced pneumothorax is sometimes followed by tuberculous empyema. It is inevitable that occasionally infected tissue will be cut and allow tubercle bacilli to invade the pleural cavity. The resultant empyema is an even more serious complication than hemorrhage. Drash has reported a series of 251 pneumonolyses performed on 230 patients; of this number, 6 (2.6 per cent) were followed by pure tuberculous empyema. However, Drash has pointed out that an even higher percentage of patients with artificial pneumothorax develop empyema and that, therefore, the operation of closed pneumonolysis is not unduly hazardous. In the patients reported by Drash tuberculous empyema developed from two to thirty months after operation and there is some question whether the operation itself was a cause. However, when adhesions are divided by the galvanocautery or high-frequency current a coagulum forms at the site of division. Eventually the eschar that has formed may separate and allow previously sealed infected channels to communicate with the pleural cavity. Separation of the eschar may not occur for many months.

Mistral has observed tuberculous empyema in about 2 per cent of the patients in whom thoracoscopy and division of adhesions had been done. This percentage is agreed to by most operators. Hall has reported an interesting case of extrapleural pyopneumothorax which developed after the division of adhesions. In his patient tuberculous empyema occurred soon after thoracoscopy and this was treated by aspirations and oleothorax. However, the patient developed an extrapleural pocket of pus and air over the apex of the lung. It is Hall's belief that pus from the empyema penetrated the pleura through the pleural wound at the parietal attachment of the severed adhesion.

Although tuberculous empyema does occur as a complication of intrapleural pneumonolysis, the incidence is much less than it is in any series of artificial pneumothorax.

THE INFLUENCE OF THE TYPE OF PULMONARY DISEASE

It is of great interest that Skavlem and his associates in Cincinnati have found that the majority of cases of empyema developed in patients in whom pneumothorax was used in the presence of exudative pulmonary lesions. They have found that patients with exudative pulmonary lesions very commonly have fibrocaseous pleurisy and in the involved areas of the pleura tubercle bacilli can be demonstrated readily. Eighty per cent of their cases of tuberculous empyema had either exudative pneumonic lesions or chronic fibroid lesions with caseous bronchopneumonia. For this reason Skavlem and his associates believe that artificial pneumothorax is contraindicated in the treatment of a predominantly exudative type and particularly so if the lesions are quite extensive or if the patient is very toxic. Barnwell does not agree with this belief; he thinks that in a patient with severe acute tuberculosis, "the illness is severe in any case and the danger of empyema with pneumothorax is probably not as serious as the dangers of the natural evolution of this type of tuberculosis."

Sayago and Lastra believe that empyema is of more frequent occurrence and more serious in the presence of caseous disease in the lung than with chronic productive pulmonary lesions. They think that artificial pneumothorax should rarely be used to treat very early caseous lesions or superficial cavities with surrounding exudative reaction. Among 72 cases of parapneumothoracic empyema, 55 (76 per cent) had caseous or fibrocaseous tuberculosis.

Nicklas, Franklin, and Zavod think that pleural effusions, and particularly empyema, develop most frequently when pneumothorax is used in the treatment of acute tuberculous pulmonary lesions. They found that 32 per cent of patients with acute tuberculous pulmonary disease de-

veloped "hot effusions" as a complication of artificial pneumothorax; but only 19 per cent of the patients with chronic fibroid disease developed "hot effusions." Many of these patients who had effusions with febrile reactions developed empyema, and all cases of tuberculous empyema developed as the transition of a "hot effusion."

Jonsson has studied 80 cases of parapneumothoracic tuberculous empyema and has found that it occurred most frequently in patients with exudative pulmonary disease. Twenty-nine of his patients had advanced exudative disease and 31 had moderately advanced pulmonary tuberculosis of an exudative character; the remainder had combined exudative and productive disease. Empyema occurring with far advanced exudative disease was more serious than with the other type of disease and there was a greater incidence of secondary infection.

There is little doubt that parapneumothoracic tuberculous empyema occurs more frequently when artificial pneumothorax is used to collapse a lung which is the site of exudative and caseous disease. Before using artificial pneumothorax in this type of disease the physician should be well aware of the dangers that may attend his treatment and should carefully consider whether it might not be better to use another form of treatment. Artificial pneumothorax should not be used routinely or without complete understanding that in a large number of cases serious complications may ensue. Nor should this treatment, if not immediately effective in producing the desired results, be long persisted in. The treatment of pulmonary tuberculosis in all its stages is not a matter to be left entirely in the hands of the internist; instead it should be the co-operative effort of the medical specialist and the thoracic surgeon.

Lawrence Roberts has pointed out that constant or recurrent pleural pain in pulmonary tuberculosis indicates well marked tuberculous infection of the pleura and that such pain therefore contraindicates artificial pneumothorax since empyema is very likely to complicate this treatment.

Barrena has stated that injury to the lung in administering pneumothorax occurs frequently and may be the cause of a bronchopleural fistula and empyema. The needle may directly traumatize the parenchyma of the lung or it may be introduced into a pleural adhesion and allow air and tubercle bacilli to enter the pleural cavity from infected areas. If perforation of the lung occurs at the site of a pulmonary lesion, pleural infection will almost inevitably develop. Sayago and other authors agree with Barrena that such injuries are a cause of tuberculous empyema but most of them believe that it is an infrequent occurrence. Barrena emphasizes that operative injury is but rarely due to faulty technique.

DIAGNOSIS

In general, the steps to be taken in the diagnosis of tuberculous empyema are those that are essential to the diagnosis of any intrathoracic disease. The history and physical examination should precede more specific examinations. Roentgenograms and fluoroscopic examination are essential for early diagnosis and accurate localization of the pus and for determination of the condition of the underlying lung. In tuberculous empyema the state of the lung on that side is of far greater importance than it is in non-tuberculous empyema. Quite different treatment may be necessary if there is uncontrolled tuberculosis in the underlying lung than would be used if insignificant or healed disease did not preclude rapid re-expansion of the lung to close the empyema cavity.

Next in importance and not to be neglected is aspiration of at least enough fluid from the pleural cavity to adequately determine the type of infecting bacteria and the nature of the pus. Bacteriological examination should include that of stained smears of concentrated fluid, cultures on suitable and effective artificial media, and guinea-pig inoculation if necessary. The fluid in all cases should be examined for organisms other than tubercle bacilli. Secondary infection of tuberculous empyema is not an unusual occurrence.

Ameuille believes that in individuals over fifty years of age pleurisy with effusion is caused by tuberculosis or by the presence of a neoplasm and that the prognosis is bad in either case. He believes that cytological examination of the fluid and roentgenological examination will establish the diagnosis. Cytological examination of pleural fluid should consist of centrifuging large quantities of fluid, fixing the sediment in suitable preparations such as Zenker's solution, and the microscopic examination of stained sections of the resultant "button" of tissue.

Murakami has made bacteriological studies in 44 cases of empyema; of this number 18 were acute and 26 chronic. In 4 of the acute cases and in all of the chronic cases tubercle bacilli were found. It is important that repeated examinations of the pus be made if there is any suspicion of tuberculosis; and there should be suspicion in every case of chronic empyema and in every case

with insidious or uncertain onset. Hedblom believes that a family history of tuberculosis is of some value in diagnosis, as is a history of insidious onset without previous infectious disease, especially if accompanied with fever, night sweats, loss of weight, loss of appetite, and progressively increasing nervousness. He thinks that pleurisy with a serous effusion in an adult is of equal diagnostic value with hemoptysis. In cases without drainage, sterile purulent fluid in the presence of fever and low leucocyte count is almost certain to be tuberculous according to Hedblom. This, I believe, is an untrustworthy criterion since often very old non-tuberculous empyemas will contain pus from which pyogenic organisms can be recovered only with great difficulty, if at all. Hedblom has also stated that the presence of tuberculosis in other organs lends weight to the diagnosis of tuberculous pleurisy. Sputum which contains tubercle bacilli is of great diagnostic significance.

MacDonald has stated that seropurulent or purulent pleural fluid which contains no pyogenic organisms should be considered tuberculous. He has also stressed the importance of the presence of active pulmonary tuberculosis and sputum which contains tubercle bacilli in the diagnosis of tuberculous empyema.

Diagnostic aspiration should in all cases be preceded by the study of roentgenograms to facilitate accurate localization of the pus and to enable the operator to introduce the needle in the proper place. If ordinary postero-anterior views are not sufficiently informative, then lateral, oblique, and other projections should be made. The location of loculated fluid should be outlined by determining the overlying interspaces and measuring the distance from the spinous processes if posterior, and from the midsternum if anterior. The aspirating needle should be introduced at this point. Blanco and Urioste have found a supraclavicular route useful in aspirating apical effusions or pus. The aspirating needle is inserted through the skin in the angle between the clavicle and the trapezius muscle; at this point it passes through the first intercostal space and the pleura will be entered at a depth of 4 or 5 cm.

Despite diligence in attempting to establish a diagnosis of tuberculous empyema, a few cases will still be missed. Alexander and Haight have reported 8 cases of empyema in which all ordinary tests and pleural biopsies failed to reveal tuberculosis; all were eventually found to be tuberculous empyema. All of the 8 patients reported on had been drained elsewhere by costal resection for presumably simple pyogenic empyema. All required redrainage because the drainage openings were either too small or were badly placed. In all cases except 1 the history was that of an acute disease. None had roentgenographic evidence of tuberculosis; none had positive sputum; in none was a presumptive diagnosis of tuberculosis made. In all 8 cases, a pleural biopsy was taken at the time of redrainage and reported negative for tuberculosis. Subsequently in 6 patients the granulation tissue around the drainage tube assumed a tuberculous appearance and active tubercles were found in all 6. In 1 other case the granulation tissue in a Schede wound was found to be tuberculous. In the eighth case tuberculosis of the pleura was found in the second stage of a Schede procedure. It is quite apparent from this experience that almost any empyema may be tuberculous.

A pitfall in the diagnosis of tuberculosis of the pleura by histological examination has been shown to me by Dr. C. F. Graham of the Albany Medical College. He has learned that a foreign-body reaction almost indistinguishable from tuberculosis may be caused by the talc that is ordinarily used in preparing rubber gloves and rubber drainage tubes. Differentiation of the two granulomatous reactions may be made by viewing the microscopic section with polarized light. In this light the talc crystals are easily seen while in ordinary light they are invisible. With polarized light it becomes obvious that the granulomas of the pleura are due to a foreign-body reaction. This reaction, of course, occurs only after the pleura has been exposed to talc from gloves or tubing. It is quite possible that some pleural reactions that have been diagnosed as tuberculous long after the initial operation are indeed due to talc.

In all cases of apparently non-tuberculous empyema, and particularly in those of long duration, a specimen of the pleura should be removed at the time of operation for bioptic examination.

Costantini has reported the clinical histories and post-mortem examinations of 2 patients with total excavation of the left lung. The signs, symptoms, and roentgenograms did not allow differentiation from a large pyopneumothorax. Costantini believes that total excavation occurs almost always in the left lung and very rarely in the right. If serial roentgenograms are available, it is sometimes possible to determine the evolution of the disease and thereby to decide whether the cavity is intrapulmonary or extrapulmonary.

Cento has described the roentgenological appearance of mediastinal tuberculous pleural effusions in children. He has studied 40 such cases, in many of which the diagnosis was confirmed by

aspiration. There are definite sites for the accumulation of fluid and his article contains numerous roentgenograms illustrative of each site. Cento states that postero-inferior mediastinal effusions are confined to a space delimited by the anterior triangular ligament anteriorly, the medial surface of the lung laterally, the chest wall posteriorly, the vertebral bodies and mediastinum medially, the diaphragm inferiorly, and the mediastinal border itself superiorly. Postero-superior effusions are confined by the medial surface of the lung, the mediastinal septum, the chest wall, and the vertebral column. Antero-inferior effusions are bounded by the pulmonary ligament, the medial surface of the lung, and the pericardium medially and anteriorly. Supero-anterior effusions are bounded by the pulmonary pedicle, the medial surface of the lung, and the chest wall.

Seyffarth has emphasized that tuberculosis should always be considered in any case of empyema with delayed healing. He has reported the cases of 4 children with pyogenic empyema; healing was long delayed and tubercle bacilli were eventually found in the pus. Three other children with positive tuberculin reactions had pyogenic empyema without apparent tuberculous infection of the external fistula; in each of these children healing was greatly delayed. Furthermore, healing of the drainage wound was delayed in only 1 of 29 children with negative tuberculin reactions. Seyffarth points out that tuberculosis is often a cause of delayed healing of drainage fistulas in thoracic empyema.

Eloesser believes that one should suspect tuberculous empyema if the lung is totally collapsed at the hilar side of the empyema cavity. He has found that pyogenic empyema later may be complicated by tuberculosis as though the suppurative process had opened channels to previously latent tuberculous foci.

In the Case Records of the Massachusetts General Hospital there is the report of a twenty-year-old American girl who had had drainage of an empyema which had not been proved pyogenic. The draining sinus persisted for more than two years. The patient died of tuberculous meningitis after a Schede thoracoplasty. The tuberculous nature of the disease was recognized only by biopsy of the pleura at the time of the Schede thoracoplasty. Eggers has reported a very similar case except that his patient recovered after decortication of the lung and a Schede thoracoplasty.

Jalet has called attention to the often difficult differentiation of greatly thickened pleura and pleural fluid. There is of course no problem when the pleural effusion is large and consequently displaces the mediastinal structures toward the opposite side. However, in the presence of smaller amounts of fluid and mediastinal fixation, the roentgenological appearance of fluid and thickened pleura may be quite similar. Jalet suggests that when the roentgenological opacity is due to thickened pleura, the thickening and consequently the opacity extend over the pleural dome, whereas with fluid this will not be the case. That this is not always true is shown by the fact that pleural empyema may be encapsulated over the apex of the lung and by the suggestion of Blanco and Urioste that a supraclavicular route for the aspiration of fluid or pus is sometimes necessary. Kautz and Pinner have reported in some detail several cases of apical empyema.

OUTCOME OF EMPYEMA

Jepure and Braicu have listed the possible outcomes of tuberculous empyema: (1) spontaneous resorption which occurs especially in the pure forms; (2) a chronic course of five or six years with cachexia and death from amyloid disease; (3) healing may take place with extensive pleural thickening and result in fibrothorax and respiratory crippling; (4) necrosis of the visceral pleura may lead to bronchopleural fistula; (5) empyema necessitatis may result in a pleurocutaneous fistula. To these should be added pyogenic infection and the development of contralateral pulmonary tuberculosis as a result of bronchopleural fistulization.

In Hedblom's group of 143 cases of tuberculous empyema there were 30 deaths. The causes of these deaths were: generalized tuberculosis (8), sepsis and inanition (4), tuberculous meningitis (4), bilateral pulmonary tuberculosis (3), bronchopneumonia (aspiratory) (3), intestinal perforation (2), sudden aspiration of pus through bronchial fistula (2), postoperative hemorrhage (1), postoperative fat embolism (1), cardiac dilatation (1), automobile accident (1). Hedblom believes that eventually most of the patients with unobliterated tuberculous empyema cavities die of the condition.

Ollivier has reported the cure of tuberculous empyema by spontaneous external fistulization. In his case the pus contained tubercle bacilli, colon bacilli, and streptococci. After several aspirations the pus drained spontaneously through a needle track. Cure with fibrosis of the left hemithorax took place after seven years of treatment with heliotherapy, sulfur baths, and fresh air. It is wise to remember that even such an

apparently happy outcome in spite of bad treatment is not always desirable. Extensive pleural thickening can too readily make a respiratory cripple of a patient. Illig has reported 2 patients with very great retraction of the chest wall as a result of old tuberculous pleurisy. Both patients had apparently healed tuberculosis for many years. Nevertheless each developed a reactivation of the pleural and pulmonary infection and spread of the disease. Natural processes of cure should not be relied upon.

Cecchini has mentioned as sequelæ of empyema severe thoracic deformities with possible encroachment on the function of the respiratory or cardiovascular systems. He has also found that in young people pulmonitis or bronchopulmonitis and bronchiectasis may result from chronicity of an empyema. There is no doubt, also, that the prolonged course of the disease is of great social and economic significance.

Amyloid disease occurs in a great many patients with tuberculous empyema. Few accurate figures concerning this complication are available since diagnosis by the injection of Congo-red in the blood stream has not been widely used until recently. I have known patients with apparent severe amyloidosis, as manifested by almost complete absorption of Congo-red, to recover after suitable treatment. In these patients at later examination almost all the dye could be recovered, and amyloid disease, if present, was certainly not clinically recognizable.

Fleischner has pointed out the differing behaviors of the visceral and parietal pleural layers in pleurisy. The parietal pleura produces more fibrin and becomes much thicker than does the visceral pleura; as a result, perforation more frequently occurs through the visceral pleura. Fleischner believes the excessive thickening of the parietal pleura is due to impairment of lymphatic drainage by compression of the lymph channels between the fluid and the stiff chest wall. Since the lung is soft and compressible, drainage from the visceral pleura is not equally interfered with. It is important therefore that the pleural fluid be removed promptly and completely in order to prevent great pleural thickening.

However, Leifer has studied 50 patients with pleural effusion. In all of these patients repeated aspirations of the fluid were done. In 41 the pleural thickening was slight; in 4 it almost completely obscured the lung; and in 5 the pleura was about a hand's breadth thick. Leifer believes that pleural thickening is a reaction of the pleura to tuberculous infection and that even repeated aspirations of the fluid will not prevent its development. Nevertheless, the prompt removal of the infected fluid will do much to reduce the pleural reaction.

Gwerder-Pedoja and Kalmar have described "macronodular pleural tuberculosis" as a complication of parapneumothoracic tuberculous empyema. Roentgenograms of the chest of their patient showed diffuse mottling of the parietal pleura with thickening to form plaques. The nodules may be either true tuberculous nodules or simple fibrin bodies adherent to the pleura. Because of the multiplicity and extensive distribution of the plaques in the case described, it is believed they were due to tuberculosis of the pleura.

Pallasse and Colas examined at autopsy a patient who died with a tuberculous pleural effusion. Both layers of the pleura were ½ cm. in thickness and typical tubercles were found on microscopic examination. There was no evidence of pulmonary tuberculosis. Penington has found that the pleural thickening begins in the subserous layer and that tubercles in the lung always cause thickening of the overlying visceral pleura. In empyema he found great fibrous thickening of both pleural layers. Tobias has reported the interesting post-mortem examination of a fifty-five-year-old man who developed severe pain in the superior part of the left hemithorax, and a left Horner's syndrome. Roentgenograms showed an extrapulmonary tumor in the upper portion of the left chest. At autopsy this was found to be a fibrous tuberculoma of the pleura. This patient had no evidence of pulmonary tuberculosis but he did have tuberculous pericarditis and fibrous obliteration of both costodiaphragmatic sulci. This type of pleural tuberculosis must be added to the various tumors that may produce the syndrome described by Pancoast as due to a superior pulmonary sulcus tumor.

More or less freely movable masses may occasionally be seen in a pneumothorax with concomitant pleural effusion. These masses are of varying sizes and have been named "fibrin bodies." Zavod has found them in 5 of 226 patients with pneumothorax. Fibrin bodies are usually ivory-colored, smooth, and glistening, and probably result from the organization of serofibrinous exudates or hemorrhagic effusions.

Pleural thickening and subsequent contraction of the scar tissue exerts considerable traction upon the chest wall and the intrathoracic structures that are contiguous to the pleura. The heart and mediastinal structures are drawn into the affected hemithorax, sometimes with im-

pairment of cardiovascular function. The diaphragm is drawn up and the ribs lie close together and indeed often overlap. Bisgard has described the transformations of the external forms of ribs overlying chronic empyema cavities. He believes that the structural changes in the ribs are brought about by the action of two physiological processes. The first of these is an inflammatory response or periosteitis which is probably most active during an acute stage of an empyema and occurs in that portion of the rib and its periosteum which is in contact with the dilated intercostal vessels and the inflamed parietal pleura. This periosteitis causes the laying-down of one or more distinct layers of subperiosteal new bone. The second factor is a functional response in which the osteogenic elements of the ribs bring about certain transformations in the architecture of the ribs. The changes that occur conform to the principles outlined in Wolff's law. The proliferation of trabeculæ and their peripheral condensation to form the thickened cortex observed in the transformed ribs represent a functional response to the contraction of the pleural scar. The ribs so affected become triangular or rectangular in shape and somewhat larger in cross-sectional dimensions. The greatest deposits of new bone are laid down along the angles of the ribs and taper off with the pleural reflections at both extremities where they become quite normal in appearance. Since adjacent ribs frequently are in contact or overlap, synostoses occasionally occur.

Scoliosis is another structural change that takes place in chronic empyema, whether or not it is tuberculous. These structural alterations are, I believe, more pronounced in tuberculous empyema than in non-tuberculous infection. Probably this is due to the added pulmonary disease that of itself is prone to undergo fibrosis and consequent contraction and thereby exerts added tension upon the extrapulmonary thoracic structures.

Retrouvey has described the tracheal and bronchial distortions that may accompany pleural and pulmonary fibrocavernous tuberculosis. Great distortion of the trachea or bronchi may occasionally interfere with the drainage of secretions from the corresponding portion of the lung. In general, however, the chief significance of tracheal and bronchial deviations lies in the technical difficulties they may offer in making a bronchoscopic examination. Tanturri and Lucioni have studied the effects upon the esophagus of pleuropulmonary tuberculosis and various forms of pulmonary collapse therapy. They have reported 40 cases of esophageal deviations due to pleuropulmonary tuberculosis. Their article is admirably illustrated with reproductions of roentgenograms and contains a good review of the pertinent literature. They have found that in the majority of cases these deviations are partial and limited to the superior part of the thoracic esophagus. However, they may occur in the inferior or even in the subdiaphragmatic portion and they may involve even the entire esophagus. In subtotal deviations the esophagus is relatively fixed at the level of the crossing of the bronchus and aorta. These deviations are due to pulmonary or pleural sclerosis. Deformations and diverticula of the esophageal wall may also occur. In pneumothorax, Tanturri and Lucioni believe that esophageal deviations may occur as a result of the inspiratory inflation of the healthy lung and the pulsion effects of the pneumothorax. At the conclusion of the pneumothorax the esophagus returns to its normal position. These deviations are not associated with similar deviations of the other mediastinal structures. There is no parallelism between esophageal and tracheal deviations. There are, furthermore, almost no clinical symptoms which may be attributed to esophageal displacements or distortions of this type. I can agree with Tanturri and Lucioni that even extraordinary alterations in the position and shape of the esophagus as a result of traction by pleural fibrosis seldom cause any symptoms. Maier and I have found deviations and dilatations of the esophagus in patients in whom pneumonectomy had been done but none had any disturbance of deglutition or digestion.

Pleural thickening does, of course, considerably impair the respiratory function of the underlying lung. Boico has found that the vital capacity and effective respiration are considerably reduced in pulmonary tuberculosis and that pleural fibrosis causes an even greater reduction in the vital capacity than does simple pulmonary disease.

Bernard, Bernal, and Gonzales have found that in some tuberculous patients who have had spontaneous or induced pneumothorax there develops marked retraction of the hemithorax and mediastinal structures. In such cases the roentgenological appearance is that of a rather opaque affected side and has been thought to be due to fibrothorax. These authors have reported 5 cases in which this roentgenological appearance was found and was thought to be due to great pleural thickening. However, subsequently it was found to be caused by recurrent pleural effusion.

Tuberculous empyema and resultant pleural thickening may at length be a cause of calcification of the pleura either in plaques or throughout both layers of the pleura. Most frequently pleural

calcification is the result of tuberculosis but this is by no means always the case, since non-tuberculous empyema and hemothorax often produce calcification of the pleura. Krauss has reported the case of a patient with chronic tuberculous pleurisy and a residual circumscribed pocket in the axillary region. The walls of this pocket contained a large amount of calcium.

Pleural tuberculosis may occasionally cause rather severe symptoms, apart from those caused by the fluid that usually accompanies it. Mantoux has described a type of pleurisy, usually without effusion, and characterized by persistent fever and plaques of thick pleura and occasionally calcification. He has found local tenderness and even severe pain at the sites of the pleural disease. For the relief of the pain in such cases and in fibrinous parapneumothoracic pleurisies, Schoenemann has found short-wave therapy very useful. Mueller has described as "pleural phlegmon" a type of pleurisy with great thickening of the pleura and severe constitutional reactions. In such cases the pleura is edematous and the site of active interstitial infection.

Pleural symphysis is most often the end result of the healing of pleurisy following the absorption or removal of the fluid or pus. However, this is not always the case. DeMichelis has reported 3 cases in which artificial pneumothorax had been abandoned for three years because of pleural effusion. In each case the fluid had apparently been completely resorbed, but in each case a total and effective pneumothorax was re-established when reactivated pulmonary tuberculosis made collapse therapy necessary. Houcke and Dupire have had 2 patients in whom induced pneumothorax had to be abandoned because of obliterative pleuritis. More than a year after pleural symphysis was apparently complete, each of these patients developed spontaneous pneumothorax and subsequent total mixed infected tuberculous empyema. Kirch has been able to induce a satisfactory therapeutic pneumothorax long after complete absorption of a pleural effusion. In doing so he found it advisable to use a sharp needle in order to prevent emboli and injury to the thickened pleura and the lung.

Rarely tuberculous empyema or serofibrinous pleurisy may have bizarre side effects. Codvelle and his associates have reported the case of a patient with serofibrinous tuberculous pleurisy who developed bilateral ulnar-nerve paralysis of very short duration on the contralateral side but quite persistent on the affected side. They believe that the paralysis was due to true tuberculous polyneuritis rather than to mechanical involvement by the fibrotic pleura. Olmer has reported an entirely similar case and with his associates believes that the condition is due to tuberculous neuritis rather than a result of pressure, traction, or general toxicity. Sattler had a patient with parapneumothoracic tuberculous empyema on the left side. Very suddenly the patient died of hemorrhage into the empyema cavity. At autopsy there was found a tuberculous aneurysm of the left subclavian artery 20 mm. from the aorta; the medial surface of the aneurysm had perforated into the pleural cavity. Sattler believes that such an accident must usually occur on the left because of the proximity of the left subclavian artery and the left pleural cavity.

Chaletzkaja has produced open pyopneumothorax in dogs and has studied the effects on the thoracic aorta. The first alteration was necrosis of the media and this was followed by inflammatory changes in the media and intima and later fibrous thickening of the intima. The result was the production of a mycotic aortitis and aneurysm. Doubtless the same series of events took place to produce the disaster reported by Sattler.

PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE PUS

The physical and chemical characteristics of tuberculous pleural effusions have been studied by several authors in an effort to find a means for differentiating such effusions from pleural fluid due to carcinoma, rheumatic fever, or other causes.

Cohen, Faraci, and Pollak have studied the sedimentation of erythrocytes in pleural fluid. Their method was to replace the sodium citrate ordinarily used in determining the sedimentation rate by the pleural fluid to be studied. They found that the sedimentation rate was rapid in inflammatory effusions with a high protein content and slow in fluids of non-inflammatory origin with a low protein content. In pleural exudates the rate is higher than that in the patient's plasma. Transudates produced a horizontal line, serous exudates gave a diagonal line, and purulent fluids produced a vertical line or curve when the sedimentation rates of the patient's erythrocytes were charted.

The Weltmann serum coagulation reaction has been suggested as a method of diagnosis in the presence of a pleural effusion or empyema. The Weltmann reaction depends upon the fact that blood serum coagulates in different solutions of calcium chloride under varying conditions of toxemia and tissue destruction. Bauer and Voigt-

laender have found the test of little value in patients with tuberculous pleurisy because it is too much influenced by the underlying pulmonary tuberculosis. Dissmann and Nassau have used pleural fluid instead of serum in the Weltmann coagulation reaction and propose the test as a means of differentiation between transudation and exudation in pleural effusions with pneumothorax; they believe that when coagulation of the pleural fluid is within normal limits, the fluid is a transudate rather than an exudate. However, these authors are rather tepid in their advocacy of the Weltmann reaction as a help toward diagnosis. It is probable that the results of the test are not worth the technical bother that must be expended.

The cytology of pleural effusions has been suggested as a means of differentiating primary from secondary tuberculous pleural effusions, tuberculous from non-tuberculous effusions, and simple effusions from empyemas. Marcoux has described the cytology of primary and secondary tuberculous effusions in 98 cases. The early stages of primary effusions are characterized by numerous macrophages with few red blood cells, polymorphonuclear leucocytes, and lymphocytes. From the twentieth to the fortieth days of the effusion polymorphonuclear cells predominate and the other cells are found in lesser numbers. Lymphocytes are found in increasing numbers after the twentieth day and soon represent from 80 to 95 per cent of all cells. Lymphocytosis ordinarily persists until complete absorption of the fluid has taken place. In the final stages of the effusion eosinophilic cells are found (5 to 7 per cent). Marcoux has found that secondary tuberculous effusions are characterized by a small number of red blood cells with a large number of polymorphonuclear leucocytes and few lymphocytes. In empyema the characteristic cells are polymorphonuclears with caryolytic and pycnotic nuclei.

Merklen, Waitz, and Kabaker have studied the cells of pleural fluids by means of supravital stains. They found that epithelioid cells and monocytes have the greatest phagocytic power and that lymphocytes and plasmacytes have almost none. Audo-Gianotti has also studied the phagocytic power of the cells of pleural fluid by means of suspensions of India ink. The greatest degree of phagocytosis was done by cells of histioid origin and mesothelial cells. Granulocytes were only slightly phagocytic and cells of the lymphocytic group were not at all so. Because of the preponderance of lymphocytes in tuberculous effusions, phagocytosis is very slight.

Chemical studies of pleural fluids have been made with varying results. Herms has found that the sugar content of the effusion is around 10 mgm. per cent; it is always less than the blood sugar. More extensive sugar reduction is caused by long-standing exudates and empyemas. Herms also believes that in old tuberculous effusions a high fibrin content is a sign of resorption. Cattaneo and his associates have identified certain enzymes in tuberculous pleural fluids; in clear fluids amylase and esterase may be found; in tuberculous pus lipase, phosphatase, and a tryptic enzyme are also present. Lenci and Tosi have found that in tuberculous empyema the fibrinogen and globulin components are much higher than in serofibrinous effusions. They believe that a ratio may be established between the total proteins and the polypeptides, $\frac{\text{total proteins}}{\text{polypeptides}}$. When this ratio is greater than one, the fluid may be considered serofibrinous; when it is less than one, the fluid is empyema. Pinner and Voldrich report that pleural fluids from tuberculous patients contain lysozyme in high concentrations; they have found that lysozyme apparently is active only against non-pathogenic organisms.

Courmont has found that the fluid which complicates artificial pneumothorax does not coagulate spontaneously except in rare cases, whereas that which forms with spontaneous pneumothorax does coagulate readily; he believes that this is a valuable diagnostic test.

Canova and Agnello have studied samples of parapneumothoracic effusions taken over a period of months. These specimens were examined for: (1) appearance (color, consistency, transparency); (2) specific gravity; (3) surface tension; (4) dry residue; (5) potential reaction; (6) actual reaction (pH); (7) total nitrogen; and (8) amino nitrogen. They concluded that only the potential reaction, the actual reaction, and the amino acids revealed dependably the evolution of the effusion. These determinations showed that the more purulent fluids were more acid and had a higher amino nitrogen. The potential reaction determined by the quantity of NaOH N/10 necessary to change the color of phenolphthalein to red, varied from 0.4 to 1.6 c.cm. and is directly proportional to the severity of the pathological process. The actual reaction, pH, at 37°C. was from 7.2 to 7.8 and paralleled the improvement of the pleural reaction. The total nitrogen varied from 0.8 per cent to 1.57 per cent. There was no significant relation between the nature of the fluid and the nitrogen content. The amino nitrogen varied from 0.00982 to 0.154 per cent. In this

there was a direct relation to the evolution of the effusion, since it was less in the less purulent effusions.

Despite the fact that some of the physical, cytological and chemical characteristics of tuberculous pleural effusions may be of help in diagnosis, nevertheless the ultimate diagnosis depends upon the presence or absence of the tubercle bacillus and the patient's anamnesis. And although variations in cellular components and chemical elements may be of slight prognostic value, nevertheless the number of bacilli, the presence of bronchopleural fistulas, and the state of the underlying lung are of far greater importance.

Pinner and Moerke in a study of 32 specimens of pleural fluid from 16 patients found that as the total cell count of the effusion increased there was a definite tendency to a higher percentage of neutrophiles. They were unable to find a relation between the cytology of the fluid and clinical phases. They also studied the physical, chemical, and serological characteristics of the fluids and concluded that "neither chemical, nor cytological, nor serological data afford *per se* dependable diagnostic or prognostic criteria."

BACTERIOLOGY

Since tuberculous empyema is, in almost all cases, due to the direct invasion of the pleura by tubercle bacilli from pulmonary foci of infection, it is to be expected that tubercle bacilli should be readily demonstrated in the pleural fluid. The frequency with which the bacilli will be found in any series of cases of empyema depends upon the method used for their identification, the nature of the fluid and its age when examined. In clear parapneumothoracic pleural effusions tubercle bacilli are found much less frequently than in cloudy, turbid, or purulent fluids.

Agnello has studied 10 cases of parapneumothoracic effusions; he found that tubercle bacilli present in the fluid or introduced into it did not grow readily. However, he was able to obtain a rich growth of the bacilli by adding synthetic media to the pleural fluid. Agnello thinks, therefore, that pleural fluid is not bactericidal to the tubercle bacillus but is simply an unfavorable medium for its growth. Bezançon and Buc report that by culture on a glycerine potato medium tubercle bacilli were found in 22 of 24 cases of parapneumothoracic effusions in which the fluid was cloudy, turbid, or purulent. Such fluids are virulent to guinea pigs and remain so for about two months of incubation, after which the degree of virulence diminishes and eventually disappears. This is not due to any bactericidal property of the pleural fluid since suspensions of human tubercle bacilli in saline solution also lose virulence after incubation for two months. In effusions that remain within the chest for many months, it may be difficult to find tubercle bacilli if repeated seeding of the pleura has not occurred. Bezançon and Buc believe also that all pleural effusions contain tubercle bacilli which may be readily cultured if the proper medium and technique are used; they believe it is important that a large amount of fluid be used and that the culture medium have an acid reaction.

Cento has made bacteriological studies of parapneumothoracic exudates and has obtained 47 positive cultures among 57 cases; positive cultures were obtained in all of 16 cases with cloudy fluid and in 8 with purulent fluid.

Courcoux and Bergeron cultured on Loewenstein's medium, specimens from 22 cases of pleural exudates; tubercle bacilli were found in 16 (72 per cent). Negative cultures were found only in effusions or pus that were very old and had long been in the pleural cavity; exudates of recent development always contained tubercle bacilli.

Courmount and Gardère believe that pleural fluid does have bactericidal properties and think they have demonstrated a bactericide for tubercle bacilli in both pleural fluid and the blood serum of tuberculous patients. It is possible that their results are to be explained on the basis of the unsatisfactory growth of tubercle bacilli in pleural fluid and similarly in blood serum; however, their data are of considerable immunological interest.

Dwelshauvers' experience in growing tubercle bacilli from pleural effusions and empyemas has been similar; he obtained positive cultures from 22 of 27 cases with clear or cloudy serofibrinous effusions and from 10 of 11 purulent fluids. The negative cultures were found only in very old fluids. Dwelshauvers found that the pH of empyema fluid was always between 7.0 and 7.2. Ferrari and Bonezzi planted pleural fluid on Loewenstein's medium in 32 cases of pleural effusions; 10 of these were serofibrinous fluids complicating pneumothorax, and, in all, tubercle bacilli were found on culture; positive cultures were obtained in 11 of 14 cases of empyema and the 3 cultures that were negative were all very old. Negative cultures were reported in 3 effusions that occurred during re-expansion of the lung and in 4 cases of primary effusion. In all of these 32 cases tubercle bacilli could not be found in stained smears of the fluid.

Levaditi and Coletsos also have found that stained smears, even after concentration, often

fail to disclose organisms that may be grown on artificial media. They studied 219 pleural exudates and had positive cultures in all but 9. In 73 fluids tubercle bacilli were grown in cultures when the concentrated smears were reported negative. Nanu-Muscel and his associates believe that culture of pleural fluid on Loewenstein's medium is a more delicate means of finding tubercle bacilli than is guinea-pig inoculation. They obtained positive cultures in all of 21 cases with serofibrinous fluid; guinea-pig inoculation was done in 15 of these but with only 3 positive results. Gloyne, however, disagrees that Loewenstein's culture medium is more satisfactory than guinea-pig inoculation.

Nedelkovitch has studied the problem of the disappearance of tubercle bacilli from pleural exudates. He has studied fluids from 11 patients with parapneumothoracic effusions by culture and guinea-pig inoculation. Of these 11 patients, 6 had tuberculous empyema which became completely cured. It was found that exudates, even when they disappear spontaneously, do not become bactericidal for their own bacilli *in vitro*. Also, specimens removed within the first months after the appearance of the effusion maintain their virulence for many months. Nedelkovitch believes, therefore, that the effusion fluid itself does not destroy the bacilli. Even the last drops of fluid obtained before the complete cure of the pleurisy still contain living and virulent tubercle bacilli. Nedelkovitch states that the cure of tuberculous empyema or simple pleurisy depends upon the relation between the virulence of the bacillus and the defensive reactions of the patient. At the moment when a cure begins it would seem that the patient becomes insensitive to the action of the bacilli. In tuberculous empyema the first specimens removed maintained their virulence throughout the entire course of the disease. The last specimens removed were somewhat less virulent than the early specimens, but it is believed that this was due simply to the aging of the bacilli. Because viable and virulent bacilli may be found even in the last bits of fluid that remain in an otherwise cured case, recurrences are possible when the resistance of the patient becomes lowered and allows the bacilli to gain the upper hand. In tuberculosis the infected patient or animal tends to protect itself in two ways: by walling off the bacilli (bacteriopexy) and by destroying them (bacteriolysis). Bacteriopexy takes place by phagocytosis and by the walling off of the bacilli by polymorphonuclears, phagocytic cells of the pulmonary alveoli, and above all by monocytes and reticulo-endothelial cells. Lysis is carried out by monocytes and plasmatocytes. Even in sensitized animals bacteriolysis is not always complete.

Oshima, Suzuki, and Suzuko obtained positive cultures in 42 of 51 patients with pleural effusions (84.4 per cent). They found cultures were always positive when the specific gravity of the fluid was greater than 1.020 and when the albumin content was greater than 5 per cent. Among 42 cases with positive cultures, tubercle bacilli could be found microscopically on smears of the fluid in only 2 (4.8 per cent).

Saenz and Chevé have compared the results of cultures and guinea-pig inoculation in demonstrating tubercle bacilli in pleural fluid. They studied 93 pleural fluids and found tubercle bacilli in 42; in 38 culture and guinea-pig inoculation were both positive; in 3 the cultures were positive but the guinea pigs died before developing tuberculous lesions; in only 1 of their cases was the guinea-pig test positive while the culture remained sterile. They conclude that culture on artificial media is a more satisfactory, easier, and cheaper method for identification of tubercle bacilli than is guinea pig inoculation. In another paper, Saenz, DeMiguel, and Costil report studies of 15 pleural effusions with 9 positive cultures, but in only 6 did guinea-pig inoculation give a positive result.

Tomita has obtained 480 positive cultures from 574 patients with pleural effusions (83 per cent); of these 5 had empyema and tubercle bacilli were found in the pus of all these.

Trossarelli found that pleural fluid with a pH above 8.1 inhibited the growth of tubercle bacilli in artificial media.

These rather impressive data demonstrate with what frequency tubercle bacilli may be found in parapneumothoracic pleural effusions when a determined search is made for them. It should be remembered that stained smears even of concentrated material are a most unsatisfactory method for identifying tubercle bacilli in such material. Culture on suitable media or guinea-pig inoculation are the only satisfactory methods. It is, furthermore, of the greatest importance that a determined, well guided and intelligent search for tubercle bacilli be made in all persistent parapneumothoracic effusions. The prognosis and consequently the management of such an effusion depends to a considerable degree on whether tubercle bacilli are present in the fluid. For example, it is certainly important to know whether fluid that appears during the re-expansion of a lung is simply of mechanical origin or is due to bacillary invasion of the pleura; intelligent

treatment depends in part upon the laboratory's ability to find or not to find the bacilli.

DeCecio and Potter have studied the clinical courses of 63 patients with parapneumothoracic effusions. Of this group 34 were found to have fluid that contained tubercle bacilli at the first or subsequent examinations (54 per cent), and tubercle bacilli were found in 80 per cent of the fluids that were cloudy or opaque. In 29 cases tubercle bacilli could not be demonstrated although 6 of these had cloudy or opaque fluid. Among the 34 patients with positive fluid complete resorption of the fluid occurred in only 12 (35 per cent), 10 developed empyema (30 per cent), and 10 developed bronchopleural fistula (30 per cent). However, in the group with negative fluid complete resorption occurred in 18 (62 per cent), bronchopleural fistula in 1 (3.4 per cent), and empyema in none. The patients with negative fluid required no other treatment than aspiration of the fluid, but of those with positive fluid 6 required external drainage and 1 a thoracoplasty. From these figures it is apparent that the outlook for a patient with parapneumothoracic effusion that contains tubercle bacilli is less favorable than that for one with fluid that is nonbacilliferous. I repeat that pleural effusions that contain tubercle bacilli require active and energetic treatment designed to rid the pleural cavity of material that threatens the patient's welfare. I would add to this that aspiration for diagnosis should be done whenever fluid persists within the pleural cavity or more than fills the costophrenic sulcus. The subsequent treatment or lack of treatment should then depend upon whether tubercle bacilli can be found in the fluid. The search for the offending bacillus must often be long and persistent. Waltner has reported the case of a child with empyema from whom the pus was repeatedly negative for all organisms. Eight weeks after the onset tubercle bacilli were found in the fluid. Among the group of 63 patients studied by DeCecio and Potter, the fluid was negative for tubercle bacilli in 42 at the first examination, but in 13 of these tubercle bacilli were subsequently found.

TREATMENT

Tuberculous empyema is a serious local manifestation of a grave constitutional disease. Consequently treatment involves the adequate care of a patient with a chronic systemic illness and the specialized treatment of a locally suppurating infection. In every case of tuberculous empyema the state of the underlying lung to some extent will modify treatment of the empyema.

Since tuberculous empyema is most often a complication of induced pneumothorax, in most cases it develops even while the patient is under the care of a physician. Often pleural infection can be prevented and just as often it is possible to avert the severe tuberculous empyema that threatens when a parapneumothoracic effusion first develops.

It is desirable that tuberculous empyema be classified in a way that makes it possible to understand what must be accomplished by any form of treatment. It is neither necessary nor desirable that such a classification be a complex one. In my opinion a clinical classification is most satisfactory. In 1932 Hedblom subdivided his reported cases into four groups: Group I—tuberculous empyema without clinical evidence of active pulmonary tuberculosis and without pyogenic superinfection; Group II—tuberculous empyema without clinical evidence of active pulmonary tuberculosis but with superimposed pyogenic infection; Group III—tuberculous empyema with active pulmonary tuberculosis and without pyogenic infection; and Group IV—tuberculous empyema with active or uncontrolled pulmonary tuberculosis and with pyogenic infection.

Consideration of each case according to such a classification will most often enable one to suggest proper and adequate treatment. Alexander has said that in Groups I and II, patients without active pulmonary disease, treatment should be directed toward getting the lung to expand and to fill the empyema cavity; but in Groups III and IV the actively tuberculous lung should usually be kept collapsed. That is a generally desirable idea. An often repeated medical aphorism is that every case should be considered individually and treated accordingly. As with all such apothegms, this one contains a respectable idea that must be liberally treated to make it workable. Principles of treatment are not based upon solitary cases but are derived from the accumulated experience offered by many similar cases. The fact that one or several patients with tuberculous empyema recovered with no treatment or in spite of some bizarre treatment does not justify neglecting the disease in another patient or perpetuating an unsound method. Treatment of patients with tuberculous empyema should, I believe, be carried out more or less according to a plan formulated by the physician and the thoracic surgeon, and based upon methods that have proved of the greatest value in the greatest number of cases.

It is difficult to estimate the value of any particular method of treatment from periodical reports since empyema may be a mild and uncom-

TABLE I.—RESULTS OF TREATMENT OF 2,009 CASES OF TUBERCULOUS EMPYEMA (COLLECTED REPORTS FROM 1930 TO 1941)

Type of Treatment	No. of Cases	Cured		Improved		Unimproved or worse		Deaths		Untraced No.
		No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	
No treatment	59	3	5.1	4	6.8			52	88.1	
Phrenic interruption	12	4	33.3	2	16.7			6	50.0	
Aspiration with or without chemicals or dyes	710	238	33.5	124*	17.5	81	11.4	251	35.4	16
Oleothorax	180	57	31.7	51	28.3	10	5.6	61	33.9	1
Surgical drainage	394	67	17.0	85	21.6	35	8.9	207	52.5	
Thoracoplasty with or without drainage	654	284	43.4	184	28.1	28	4.3	155	23.7	3
Totals	2,009	653	32.5	450	22.4	154	7.7	732	36.4	20

*Fifteen of these waiting for thoracoplasty.

plicated disease or it may be severe and associated with scattered tuberculous infection. It is not likely that a patient with tuberculous empyema, bilateral pulmonary tuberculosis, and tuberculous enteritis will do as well under any form of treatment as will one with parapneumothoracic empyema and well controlled unilateral pulmonary disease. The efficacy of any method of treatment will depend to a large degree upon the type of cases that are treated. Evaluation of a method depends upon one's knowledge of the type of patients on whom it was used. Unfortunately, this important information is too seldom included in reported series of cases.

One should not slavishly insist upon using any particular method of treatment in all cases, nor should one hold the conviction that any one method excels all others. One should be prepared to give each a proper trial and to abandon it if it does not help the patient. Generally the treatment should be as simple as possible and still be able to cure the empyema. Castelli considers that treatment of tuberculous empyema depends upon the following: (1) the purulent exudate should be evacuated by some means; (2) the continuation of a necessary therapeutic pneumothorax with complete cure of the empyema represents the optimum result, but generally obliteration of the cavity is essential to a cure; (3) tuberculous lesions of the underlying lung must be controlled by medical or surgical methods; and (4) pleuropulmonary or external fistulas must be closed.

In general, the best methods of treatment are those that have given the best results when used by many individuals. It is fair, I think, to gather together the reported results of many authors and to determine from their figures the mortality rate and cures effected by various methods.

All cases of tuberculous empyema require active treatment. Four methods of treatment are to be seriously considered in any case. These are: (1) aspiration of the pus with or without the intrapleural injection of air, chemicals, or modifying solutions; (2) oleothorax or gelatinothorax; (3) simple surgical drainage by means of rib resection or intercostal tubes; and (4) extrapleural thoracoplasty with or without preliminary or subsequent surgical drainage.

The results obtained by these methods of treatment have been summarized in Table 1. A more detailed discussion of methods and the results of these treatments is in the text of the following sections. Unfortunately it has been too difficult to divide tuberculous empyema into the four groups suggested by Hedblom since the necessary information is often lacking.

Treatment ranges from complete neglect to the radical and often mortal operations of total thoracoplasty and pleurectomy. The former method has no justification even if carried out in the hands of a physician, and the latter method should very seldom be necessary if phthisiologists and thoracic surgeons work in harmony. Keers has mentioned Duboff's results with untreated empyema; among 20 cases there were 6 in which perforation through the chest wall occurred; in 4 the pus perforated into a bronchus, and in the rest the patients died of amyloid disease. Skavlem and his associates have reported that "indifferent treatment" (bed rest, opiates, and an occasional aspiration) was followed by death in 40 of 41 patients. Every case of tuberculous empyema, potentially at least, requires surgical treatment. Therefore every case should be the combined responsibility of a phthisiologist and a thoracic surgeon for best timed surgical treatment.

Aspiration. The simplest method of treatment is aspiration of pus and the injection of sufficient air to maintain the pneumothorax. This method places the onus of elimination of infection upon the patient and depends upon the naturally curative responses of the pleura to isolate the tubercle bacilli and to destroy them by phagocytosis. In mild infections it is frequently successful. It is a desirable method when efficacious since it allows the collapse of the lung to be maintained merely by pneumothorax.

Aspiration of the pus without other treatment should be used only as long as it is an effective means of controlling the infection. Persistent toxic symptoms, rapid reproduction of pus, or a harassing cough and expectoration due to a bronchopleural fistula necessitate a change to a more effective method of treatment. Several aspirations at intervals of a few days or more should enable one to decide whether this form of treatment is satisfactory. In most cases of tuberculous empyema such mild and relatively unaided methods of treatment are quite ineffective.

Aspiration and pleural lavage. The next step is evacuation of the pus and lavage of the pleural cavity with chemical solutions that are meant to destroy the bacilli or render them more susceptible to phagocytosis. The list of antiseptics and modifying solutions is long and varied. Hayes has advocated irrigation of the pleural cavity with normal saline solution and the instillation of from 15 to 30 c.cm. of grain alcohol at the conclusion of the lavage. Gaspare recommends a solution of diformine iodobenzomethylene but otherwise follows Weiller's technique very closely. Bodo advises the use of a 1:5,000 solution of acriflavine. Blechmann and Gologan believe that a 1:4,000 solution of rivanol is the best medium for pleural lavage.

Beninato believes that the detergent effect of lavage solutions is most important. He advises using several solutions alternately. Beninato has treated 52 cases with parapneumothoracic tuberculous empyema by aspiration of the pus and pleural lavage. Of these 29 were cured (55.7 per cent); 11 became worse (21.1 per cent), and 12 remained unchanged for a year or more.

Recently Petroff and Schain have advised adding a detergent to the antiseptic solution; they recommend using 1:3,300 saline solution of azochloramide to which 40 c.cm. of tergitol (an alcohol) have been added.

Arnaud and his associates have found that a 10 per cent solution of creosote in alcohol inhibits the growth of the tubercle bacillus *in vitro.* Therefore, they have used this solution in the treatment of tuberculous empyema. While they report good results in 6 patients, they warn that the mixture is quite irritating to the pleura.

Anderson has reported a group of 17 cases of pure tuberculous empyema which were treated by pleural lavage with a 1:3,300 aqueous solution of azochloramide. Of these 17 cases 6 were cured, 6 were improved, and 5 must be considered failures. Rudman and Ellison have sought for an agent which will fulfill these qualifications: (1) it must be simple in its method of administration and require no cumbersome apparatus for its use; (2) it must not cause undue irritation of the pleura; (3) it must liquefy the débris present in the exudate; (4) it must be distinctly bactericidal to the secondary invading organisms; (5) it must have a bacteriostatic or bacteriolytic effect on the tubercle bacillus; and (6) its presence in the pleural cavity must prevent pleural symphysis. To satisfy these requirements these authors urge the use of a 1:5,000 solution of metaphen in olive oil; after aspiration of the pus, from 10 to 20 c.cm. of this solution are injected into the pleural cavity. Rudman and Ellison report cures in 4 patients treated in this manner.

Woodson and Mullen have reported their results with the use of lavages of a 1:5,000 or 1:10,000 solution of merthiolate in normal saline solution. They have treated 17 cases, of which 6 (35.3 per cent) were cured, 8 (47.1 per cent) were improved, and 3 (17.6 per cent) terminated fatally.

Rosenblatt has reported 21 cases of tuberculous empyema, 19 of which complicated artificial pneumothorax. In all of the cases treatment consisted in the aspiration of pus, air replacement, and the injection of from 2 to 3 c.cm. of a saturated alcoholic solution of methylene blue. It required from five months to two years for the surviving patients to become permanently free from fever. Eleven of the 21 patients (52 per cent) were cured and 10 (48 per cent) died. Rosenblatt believes that the important feature of treatment is the injection of methylene blue, although he admits that it is difficult to understand how so small an amount can be useful.

Many other solutions have been suggested; potassium permanganate, Dakin's solution, gentian violet, Pregl's solution, and Lugol's solution are among these. The efficacy of antisepsis of these solutions is doubtful. It is quite probable that the mechanical action of lavage is as important as the sterilizing action of the fluid used.

Pleural lavage, if worth doing at all, should be done well and thoroughly. The simple introduction of a few cubic centimeters of solution through an inferior intercostal space is scarcely worth

the effort. Thorough lavage should bathe all portions of the pleural cavity with large quantities of the antiseptic solution. In several papers Pierre Weiller, the foremost advocate of pleural lavage in the treatment of tuberculous empyema, has discussed proper methods of carrying out this procedure. Weiller believes that lavage is the simplest and most efficacious method of treating severe tuberculous empyema; he advises using normal saline or very mild iodine solutions. Lavage should be done early in the disease and a very large quantity of irrigating solution should be used; Weiller considers that a single proper treatment requires from two to four hours. The technique described by De Muralt and Weiller requires two needles, the lower of which is connected to an irrigating bottle and a drainage bottle, and the upper of which is connected to a manometer. This allows constant control of the intrapleural pressure. The patient should feel no pain and only rarely a slight sense of discomfort. If he coughs very much, codeine or morphine should be given before the procedure is started. The lower needle is inserted in the seventh or eighth interspace in the posterior axillary line if this is possible. Otherwise it is put in at the lowermost point of the cavity. The patient should be in a sitting position and, since the procedure requires a long time, should be as comfortable as possible. The skin and parietal pleura should be well anesthetized with novocaine; careful asepsis is essential. The lowermost needle should be large enough to allow the satisfactory aspiration of pus of any thickness. The proper size for the needle may be determined by preliminary aspiration. Weiller recommends the use of Jessen's solution, which consists of iodine 0.5 gm., potassium iodide 1 gm., and distilled water 4 liters. Its temperature should be 38 degrees. The upper needle should be inserted in the second or third interspace in the anterior thorax and connected with a manometer. The procedure is then alternately to aspirate pus in small quantities and irrigate with the irrigating solution in about equal quantities until the aspirated fluid is perfectly clear. To be done properly this procedure will require from 4 to 6 liters of fluid and will extend over several hours. At the end of the procedure the pleural cavity should be entirely empty. The pressure should be about zero. Postoperatively the patient should lie on his healthy side for at least two hours in order to avoid possible infection of the needle tracks.

Weiller and De Muralt have found pleural lavage very efficacious in the treatment of all types of pure tuberculous and mixed infected empyema. They wisely and emphatically state that if marked improvement does not occur after 6 weekly or biweekly lavages, surgical treatment should be promptly used. Other authors have also reported favorably upon this method.

Often arrest of the infection and sterilization of the pleural cavity is impossible and cure of the empyema depends upon obliteration of the pleural space either by expansion of the lung or by collapse of the chest wall, or by filling of the pleural cavity with medicated oil or gelatin.

Re-expansion of the lung in the presence of tuberculous empyema may be accomplished simply by the aspiration of air and fluid from the pleural space, or by aspiration of the fluid and absorption of the air.

Italian authors of the Carlo Forlanini Institute led by Redaelli, Parodi, Morelli, and Monaldi have developed a method of aspiration which has been variously described as "progressive decompression," "forced intrapleural suction," or "closed intrapleural suction." The basis of the method is the aspiration of all possible air and fluid from the pleural cavity in one or several sittings. This results in the development of very negative intrapleural pressure; the negative pressure may be as low as minus 250 cm. of water. They believe that forced aspiration in tuberculous empyema has the following effects: (1) the mechanical action of reduction in the size of the empyema cavity by concentric suction; (2) a biological rapid detoxication by removal of the infected material and reversal of the routes of absorption; (3) a sterilizing biological action on the pleural cavity by removal of the septic material and by induced hyperemia of the cavity walls; and (4) the biological action of the formation of increased blood supply in the thickened visceral and parietal pleura. This latter is very necessary to the eventual obliteration of the cavity by pleural symphysis.

According to the Italian authors, bronchopleural fistulas may be closed by this method by inversion of the mouth of the fistula. Bernou thinks that closure of the fistula is brought about by changing the position, form, and volume of the lung, which renders the fistulous track less direct, or that closure may be effected by approximation of the pleural leaves.

According to Guglielmetti of the Carlo Forlanini Institute this method of treatment consists in the periodic and frequent aspiration of pus, followed by pleural lavage, the complete aspiration of all fluid, and removal of sufficient air to leave a very negative intrapleural pressure. All who have used this method agree that when this

treatment is first used there usually develops a hemorrhagic effusion but this becomes serous as the lung re-expands. Guglielmetti believes that decompression has the following effects: (1) removal of the dense fibrous membrane and prevention of its reformation; (2) gradual transformation of the purulent exudate to a simple serous effusion; (3) gradual reduction in the amount of exudate; (4) stimulation of the production of adhesions which will maintain the lung in contact with the chest wall; and (5) preservation of the functional capacity of the lung.

Most authors believe that the intrapleural pressure after the first treatment should be left at about minus 20 cm. of water and then at subsequent treatments rapidly reduced to as low as minus 200 cm. of water. Intrapleural pressures should be only as negative as is necessary to produce the desired results. Monaldi and Pattin have pointed out that closure of broncho-pleural fistulas is effected earlier by sudden than by gradual reduction of intrapleural pressures.

Despite early enthusiasm for the forced aspiration method of treatment, Bernou and Fruchaud several years later believed that this method was usually ineffective in severe empyema with or without fistulas.

In 1936 Monaldi reported an added refinement to this method of treatment: an anterolateral thoracoplasty, usually done in two stages. Monaldi bases this reasoning upon a conception of certain mechanical factors of respiration. He believes that the chest wall exerts a pull upon the lung in certain definite directions which he calls "dominants." There are four of these, two are vertical and two are more or less horizontal. Monaldi's anterolateral thoracoplasty interrupts the forces of these dominant pulls by removing the anterolateral segments of the first to seventh ribs and by paralyzing of the diaphragm. His reported results have been good and the operation has been accepted by other French and Italian surgeons, notably Bernou and Secrétan.

Monaldi in 1935 reported 85 cases of tuberculous empyema treated by simple aspiration and lavage; of this number 65 per cent were cured of empyema and 44 per cent of pulmonary lesions. He has also reported 35 cases of empyema treated by forced suction and lavage and anterolateral thoracoplasty; of these, 92 per cent were cured of the empyema and 72 per cent of pulmonary lesions. Secrétan has reported 30 cases similarly treated; in 21 of this group the empyema and pulmonary lesions were cured; in 1 the pulmonary lesion was cured but not the empyema; 4 were improved, and 4 unchanged.

Rossi has found forced intrapleural suction useful in curing empyemas with spontaneous or surgically produced pleurocutaneous fistulas. He advises that the mouth of the fistula first be tightly blocked. Then aspiration of the pleural cavity can be carried out to produce very negative intrapleural pressures.

Treatment of tuberculous empyema by aspiration and pleural lavage or by progressive decompression and lavage has apparently been attended by good results. Each of these methods of treatment requires diligence, patience, and systematic planning. As all proponents of these methods have said, if considerable improvement has not occurred after from six to eight regularly spaced treatments, the method should be immediately superseded by surgical treatment.

Gold salts. The search for a suitable agent to destroy tubercle bacilli in the body and leave the tissues unharmed still goes on. Among the agents proposed, gold salts have maintained a considerably disputed place. Inevitably these salts of the precious metal have been used intrapleurally to cure tuberculous empyema. Schelenz has reported on 3 patients so treated; 2 died and 1 was cured. Roccas has injected gold sodium thiosulphate intrapleurally after lavage of the empyema; he has reported 2 cured cases. Ferrari and Ferroni have treated 10 patients with tuberculous empyema by the injection of gold salts after aspiration of the pus; they used solganol and phosphocrysolate and believed that good results were obtained in 7 of the 10 cases so treated.

The advocates of intrapleural injections of gold salts believe that these compounds prevent the continued secretion of pus, accelerate its absorption, increase its fluidity, and destroy the tubercle bacilli in the fluid. However, Colbert and Mollard think that intrapleural injection is quite useless and that better results are obtained by the intramuscular injection of gold salts. They point out that icterus, fatal purpura hemorrhagica, generalized erythema, and polyneuritis have often occurred following the intrapleural injection of gold salts and that, since the method is of doubtful value, it should be given up. Amat believes that gold salts have no specific action on tuberculous lesions or on tubercle bacilli; he thinks that these drugs have only a sclerosing action. Amat has treated 9 patients with tuberculous empyema by the intrapleural injection of gold thiosulfate; of this number 7 were benefited, 1 died of acute enteritis, and 1 died with hypertrophy of the liver and purpura hemorrhagica.

Lefèvre has used intrapleural injections of quinine and urea hydrochloride to produce

hyperemia and fibrosis of the pleura in tuberculous empyema; he has reported 3 cases successfully treated by this method. Harrod has reported injecting from 45 to 60 c.cm. of 95 per cent alcohol after pus had been aspirated from the empyema. His patient recovered but, as Harrod said, "It is not to be inferred from the foregoing report that the problem of the treatment of tuberculous empyema has been solved." Amorim suggests using caryogon, a sulfonated derivative of caryophyllin; he uses this drug by intrapleural injection of a 2 per cent aqueous solution and ingestion of a 7.5 per cent solution.

It hardly seems necessary to use anything at all to stimulate fibrosis in tuberculous empyema; usually there is too much fibrosis of both pleural layers. And it is certainly undesirable to use a drug that is poisonous as often as are gold salts. There is but slight evidence to support the use of these drugs and much against it.

Oleothorax. As a method of treatment of tuberculous empyema oleothorax has been in use for many years. Its virtues have been energetically debated. This method of treatment is the introduction into the pleural cavity of various medicated oils. It is doubtful whether the oils used have any specific disinfectant action; probably they act only mechanically. While encouraging results have been reported, the field of usefulness of oleothorax must remain sharply circumscribed. Absolute indications for its use are few. It should not be used as a substitute for otherwise necessary surgical methods although, as Skavlem has suggested, oleothorax may be useful in preparing a very sick tuberculous empyema patient for thoracoplasty. Enthusiasm for the virtues of oleothorax is apt to lead to rather indiscriminate use of it. In the treatment of tuberculous empyema, oleothorax may be of value in certain cases with pure tuberculous infection, with well-controlled pulmonary disease, and without open bronchopleural fistulas. It certainly should not be used when tuberculous empyema is superinfected with pyogenic organisms. Nor should it be used in the presence of large bronchopleural fistulas. It is distinctly unwise to use oleothorax in treating a parapneumothoracic empyema when the tuberculosis in the underlying lung has not been controlled by the pneumothorax. Such cases are more adequately and more wisely treated by surgical methods.

Bacon believes that parapneumothoracic tuberculous empyema is best treated by oleothorax; he thinks the oil stimulates fibrosis. Capani has made thoracoscopic examinations of the pleura after the instillation of medicated oils and has found definite fibrosis of the pleura. Simple pleural infection without oleothorax also causes pleural fibrosis.

Carmichael has reported 22 purulent effusions among 105 cases of artificial pneumothorax. Twenty of these cases of tuberculous empyema have been treated by oleothorax with a 10 per cent solution of gomenol in olive oil; 9 of the patients are well and working, 4 were benefited, 2 were not benefited, 1 had recurrence of the empyema, and 4 are dead. Davies has treated 5 patients by oleothorax and has reported cures in 3 of these.

Decleva and Berger believe that the chief indication for oleothorax is pure tuberculous empyema. Caussimon and Dervillée, however, think that oleothorax is almost never useful or desirable. Gullbring has used oleothorax in several patients with parapneumothoracic empyema; he believes that empyema with mixed infection or bronchopleural fistula will not be benefited by oleothorax but that it may be of value in some cases of chronic tuberculous empyema.

Leaver and Hardaway use a 5 or 10 per cent solution of gomenol in "Mazola." They have reported 35 cases of tuberculous empyema; of these 20 were cured and 7 improved, and 8 patients are dead. Oleothorax alone was used in 18 of the cured cases. These authors advise using oleothorax in pure tuberculous empyema and pleural lavage with a 1:5,000 aqueous solution of gentian violet in mixed infections; thoracoplasty may be a necessary supplement. Munro has reported 6 cases of tuberculous empyema treated by oleothorax; of these 4 were improved; 2 patients died. Sarno and his associates believe that oleothorax is of little value in tuberculous empyema. This opinion is shared by the Argentine Committee on Tuberculous Empyema, whose work has been reported by Sayago and Villafañe Lastra.

Skavlem and his associates believe oleothorax is useful in controlling pleural infection prior to thoracoplasty. They have used it for 40 patients with tuberculous empyema; of these 14 died, 13 were benefited, and 13 recovered. The results obtained were not as good as those produced by thoracoplasty. However, these workers think that the pre-operative use of gomenol is often beneficial in reducing toxemia. Ukil and De have treated 14 patients with tuberculous empyema with oleothorax; of this group 5 died, 2 were cured, and the remainder were sufficiently benefited to allow thoracoplasty to be done. Woodruff believes that oleothorax is of no value in the presence of mixed tuberculous and pyogenic infection. However, among 22 of his patients with

pure tuberculous empyema, 11 have been cured by oleothorax.

The most commonly used solution for oleothorax is a 5 or 10 per cent solution of gomenol in olive oil, cottonseed oil, or paraffin. Some have been disappointed with this and have tried to find a superior material. Crocket thought that the ideal would be a substance, preferably of animal origin, that would intimately intermingle with the pleural fluid and not, like olive oil or paraffin, float on the surface. To satisfy these requirements Crocket uses a solution of 2 per cent gelatine in normal saline solution; to this is added 1:2,500 acriflavine to provide an antiseptic. Crocket advises using this solution in all cases of pure or mixed infected tuberculous empyemas that cause symptoms. Gómez and Negro have also used gelatinothorax in 6 cases of tuberculous empyema; 1 of the patients was cured, 2 were benefited, 1 was not benefited, and 2 died. Decleva and Berger believe that gelatinothorax is superior to oleothorax since the gelatine solution causes less fibrosis and, since it weighs less, is less likely to cause bronchopleural fistulization. Probably the differences are slight and gelatinothorax must be considered to have the same indications and contraindications as oleothorax.

Surgical methods. Surgical treatment of tuberculous empyema has been and all too frequently still is a matter of last resort. Tuberculous empyema is of such a nature that quite obviously surgical treatment is not necessary in many cases; nevertheless any sagacious therapeutic plan for a particular patient should include a prevision of the possible necessity for surgical treatment. The presence of active or uncontrolled pulmonary tuberculosis in the underlying lung increases the need for careful surgical judgment in determining when operation should be done and what operation is most suitable. It is imperative that the desirable time for surgical intervention should not pass by while an improbable cure by other means is vainly hoped for.

Archibald has suggested that thoracoplasty be done if a seropurulent or purulent effusion continues to recur after 5 or 6 aspirations. It is Archibald's belief that many effusions that have a mild onset eventually become severe and even secondarily infected and will therefore require thoracoplasty. Archibald's advocacy of thoracoplasty in all cases of tuberculous empyema is based on his conviction that the disease is definitely and rather rapidly progressive and that thoracoplasty offers the most certain means of cure and prevention of serious general debility. Archibald's view is not generally accepted.

Brock, Mullen, and Woodson have reported on 163 patients with significant effusions, most of which were purulent and all of which were potentially empyematous; they used thoracoplasty in only 5 of these cases. Aspirations with or without modifying solutions sufficed in the other cases. They treated 62 patients with seropurulent or purulent effusions by aspiration alone; of this number 27 (44 per cent) were cured, 4 (6 per cent) were benefited, 16 (26 per cent) remained unbenefited, and 15 (24 per cent) died. Sixty-two patients with similar effusions were treated by aspiration of fluid and irrigation with various dyes; of this group 28 (45 per cent) were cured, 11 (18 per cent) were benefited, 4 (6 per cent) remained unbenefited, and 19 (31 per cent) died. Brock and his associates believe that the best results were obtained by aspiration of the pus and lavage with 1:10,000 or 1:5,000 solutions of merthiolate in normal saline solution; 27 patients were treated in this manner and of these 17 (63 per cent) were cured and 10 (27 per cent) were benefited. DeCecio and Potter have treated 41 patients with pleural effusions that contained tubercle bacilli; of these, 34 required only aspiration, 6 had external drainage, and only 1 had a thoracoplasty.

Gaetan and Smith have classified their cases of tuberculous empyema according to Hedblom's method. They have reported 26 cases in Group III (pure tuberculous empyema with active pulmonary tuberculosis), and 10 in Group IV (mixed infected empyema with active pulmonary disease). They believe that in cases in Group III aspiration of pus and lavage with azochloramide is the best treatment. Of the 26 cases in this group, 4 were cured by thoracoplasty, 15 were moderately improved and awaiting thoracoplasty; 7 patients died of extensive bilateral disease. Of the 10 cases in Group IV, 2 were cured by thoracoplasty and 8 had external drainage; of these, 6 were improved, while 2 patients died.

Head believes that patients with pure tuberculous empyema usually require only aspiration of the pus and that thoracoplasty is necessary if re-expansion of the lung is impossible or if the pneumothorax is unsatisfactory. Head also thinks that secondarily infected empyemas may sometimes be successfully treated by aspiration and lavage but that drainage by rib resection is necessary if the simpler method fails or if there is a bronchopleural fistula.

Hedblom reported 143 cases in 1932; 5 of these were in Group I, 26 in Group II, 46 in Group III, and 66 in Group IV. The treatment was varied and consisted in aspiration, irrigation and drain-

TABLE II.—142 CASES OF TUBERCULOUS EMPYEMA (HEDBLOM)

Aspiration, irrigation and drainage	Cases	Cured	Improved	Deaths		Untraced
				Cases	Per cent	
Groups I and III	28	6	6	9	32.1	7
Groups II and IV	33	3	10	13	39.4	7
Extrapleural thoracoplasty*						Incomplete
Groups I and III	22	18	2	0	0	2
Groups II and IV	59	19	22	13	23.7	5

*With or without small Schede or other plastic operations.

age, and thoracoplasty. Hedblom has divided his cases into those treated with and without extrapleural thoracoplasty, with the results shown in Table II.

In 1934 Jones and Alexander collected reports of 779 cases of tuberculous empyema from 19 articles in the literature. They found that of this number 25.5 per cent were cured, 21.5 per cent improved, 9.6 per cent unchanged, and 1.8 per cent worse; and 41.6 per cent of the patients had died. Comparison of these figures with those that I have been able to collect from the literature from 1930 to 1941 shows that there has been slight but encouraging improvement in the results of treatment. Of 2,009 cases I found that 32.5 per cent were cured, 22.4 per cent improved, and 7.7 per cent unimproved or worse, while 36.4 per cent of the patients had died (See Table I).

In addition, Jones and Alexander reported 70 cases of their own; of these 57.1 per cent were cured, 5.7 per cent improved, and 4.3 per cent unimproved or worse, while 32.9 per cent of the patients died. They had 1 case in Group I, 14 in Group II, 25 in Group III, and 30 in Group IV. In all cases aspiration and lavage was carried out as long as practicable, but all but 4 patients required subsequent surgical treatment. The results of their treatment may be found in Tables III, IV, V, and IX.

Jonsson has reported 80 cases of tuberculous empyema; of these 64 were pure tuberculous and 16 had mixed infection. In the former group treatment was by aspiration; 27 patients were cured (42 per cent), 2 benefited (3 per cent), and 35 died (55 per cent). Of the 16 patients with secondary infection, 5 had thoracoplasty and of these 3 were cured. The remainder had aspiration or suction drainage. Of these 16 patients, 6 were cured (37 per cent) and 10 (62 per cent) died. Jonsson found that the character and extent of the pulmonary disease greatly influenced the mortality rates. Patients with severe exudative disease had a mortality of 76 per cent; those with moderate exudative disease, 66 per cent; and those with productive disease, only 18 per cent. Spread of tuberculosis in the patients with exudative disease accounted for many deaths.

Keers believes that the state of the pulmonary disease is the deciding factor in the treatment of tuberculous empyema. He states that when empyema occurs in cases with positive sputum this is an absolute indication for termination of the pneumothorax and resort to thoracoplasty. Temporization in these circumstances is exceedingly dangerous. Empyema in cases with negative sputum resolves itself into the question of whether or not the pus can be disposed of without terminating the pneumothorax. In such cases Keers believes aspiration and lavage should be tried. However, if after four months' treatment the pus is still forming, then the lung should be re-expanded and thoracoplasty done. If the condition of the underlying lung in an empyema with negative sputum is such that re-expansion is impossible, unsafe, or inadvisable, then thoracoplasty should be done promptly. Keers also

TABLE III.—GROUP II, 14 CASES (JONES AND ALEXANDER)
TUBERCULOUS AND PYOGENIC EMPYEMA WITHOUT ACTIVE PULMONARY TUBERCULOSIS

Last operation	No. of cases	Cured	Improved	Unimproved	Deaths
Open drainage	4	3			1
Extrapleural and/or Schede thoracoplasty	10	8	2		
Total	14	11	2		1
Per cent		78	14		7

TABLE IV.—GROUP III, 25 CASES (JONES AND ALEXANDER)
PURE TUBERCULOUS EMPYEMA WITH ACTIVE PULMONARY TUBERCULOSIS

Last operation	No. of cases	Cured	Improved	Unimproved or worse	Deaths
Aspiration	3				3
Phrenicectomy	1	1			
Extrapleural thoracoplasty	21	16		1	4
Total	25	17		1	7
Per cent		68		4	28

believes that in the presence of a demonstrable bronchopleural fistula, lavage should not be done, but instead thoracoplasty should be immediately started. He has no patience with dilatory and trifling methods, believing as he says, "One can say definitely, however, that here is an aspect of tuberculosis therapy where conservative measures are at a discount, where early and active intervention will be amply repaid, and where the chest physician and thoracic surgeon will find a fruitful field for cooperation."

In rather the same vein Caussimon and Dervillée believe that thoracoplasty is of use only if it is done early and before great pleural thickening has occurred. It is true that better collapse is possible when the pleura is thin. Nevertheless, much can be gained by thoracoplasty even in the presence of very thick pleura.

Mourier has reported on 24 patients with tuberculous empyema; of these 3 died. Fifteen had conservative treatment and 8 recovered, while 7 were not benefited. Six had thoracoplasty; of these 1 died and 5 were cured. One was benefited by oleothorax and 2 died of contralateral pulmonary disease.

Nalbant firmly believes that some tuberculous empyemas, which previously were thought to be best treated by thoracoplasty, can be cured by aspiration with air replacement. Thus 18 cases with clear infected fluid and 9 cases of empyema were treated by aspiration, with complete resorption in 83.3 per cent of the cases in the first group, and in 88.8 per cent of those in the second group. Nicklas, Franklin, and Zavod found that empyema developed in 54 of their 125 cases with pleural effusions. They also found that spontaneous disappearance of the pus occurred in 26 per cent of these cases. Their tuberculous empyemas were aspirated twice weekly and irrigated with normal saline solution. Thoracentesis was done anterior to the midaxillary line to decrease the influence of gravity in the development of abscesses of the chest wall. Tube drainage was always done in the presence of a bronchopleural fistula regardless of whether or not organisms other than tubercle bacilli could be found in the fluid. This was done to prevent the spread of tuberculous pus through the bronchial tree. The drainage tube was inserted through an intercostal space anteriorly and connected to a siphon system, a method described by Franklin.

Nylander has reported on a series of 95 patients, most of whom had concomitant far advanced pulmonary tuberculosis and only a few had pure tuberculous empyema. Of the 95, 41 had surgical treatment: in 21 thoracoplasty was done and in 20 merely a thoracostomy. Nylander believes thoracostomy is permissible in mixed tuberculous pyogenic infection which cannot be controlled otherwise. Of the 21 patients who underwent thoracoplasty, 5 died and 2 of these because of the operation; 16 patients are living and of these 8 have been considered cured for three years; in 2 the condition is only slightly

TABLE V.—GROUP IV, 30 CASES (JONES AND ALEXANDER)
TUBERCULOUS AND PYOGENIC EMPYEMA WITH PULMONARY TUBERCULOSIS

Last operation	No. of cases	Cured	Improved	Unimproved or worse	Deaths
Aspiration	2				2
Open or closed drainage	16	3	2	2	9
Extrapleural and/or Schede thoracoplasty	12	9			3
Total	30	12	2	2	14
Per cent		40	6	6	46

Preliminary phrenicectomy was performed in 16 of the 30 cases. All of the thoracoplasty patients had had drainage.

improved after three years but the patients are bacillus-free. On the remaining patients treatment is still being carried on. In 5 the thoracoplasty had to be supplemented by a plastic operation on the muscles to fill a residual cavity. Of the 20 patients on whom thoracostomy was done, 18 had mixed tuberculous and pyogenic infection. Eleven of the 20 patients died in two months, 4 died in six months, 3 died in two years, and 2 lived more than three years.

Ornstein and Ulmar have postulated these directions for the treatment of tuberculous empyema:

1. *Pure tuberculous empyema:* The consistent presence of tubercle bacilli in the pleural exudate is evidence of a bronchopleural fistula. This is because the tubercle bacilli require a high degree of oxygen for their growth and a sufficient supply could be provided only through a bronchopleural fistula. When the underlying pulmonary disease is under control (negative sputum), when there is insufficient evidence of a bronchopleural fistula, and when the number of tubercle bacilli in the fluid is few, the best course is to leave the patient alone and depend upon spontaneous absorption of the fluid. When there is definite evidence of a bronchopleural fistula the danger of aspiration of the pleural contents to other parts of the lung is so great that energetic treatment is necessary. Thoracotomy followed by thoracoplasty is indicated. Pleural lavage with antiseptic dyes is dangerous. When the underlying pulmonary condition is not under control, then thoracotomy plus thoracoplasty should be done whether or not there is a fistula.

2. *Mixed tuberculous empyema:* Almost all of the cases of this type have bronchopleural fistulas. Occasionally satisfactory results may be achieved by aspiration and pleural lavage with antiseptics or the instillation of a modifying agent such as gomenol. If this treatment is not satisfactory, then thoracotomy followed by thoracoplasty should be done. In the presence of a bronchopleural fistula of any significance, immediate surgical drainage followed very soon by thoracoplasty should be done.

In 1931 the American Sanatorium Association appointed a Committee to study the treatment of tuberculous empyema. This Committee sent questionnaires to 75 medical men and surgeons specializing in diseases of the chest; 49 of these replied in detail. The Committee has correlated the data and believe that most tuberculous empyemas are best treated simply by aspiration to relieve high fever and the pressure symptoms. The use of chemical solutions after aspiration is of no more value than is air replacement alone. Gomenol has been too little used for an opinion to be drawn as to its use. This Committee believes that closed or open drainage is not warranted, since it at once converts simple tuberculous empyema into a pyogenic one. In pyogenic tuberculous empyema aspiration alone is no better than closed or open drainage, and drainage in the majority of cases is only the first step leading to thoracoplasty. Chemical solutions should be used in an attempt to sterilize the cavity but it is impossible to say which is superior.

In 1936 the Third Pan-American Conference on Tuberculosis appointed a Committee to study tuberculous empyema. The principal features studied were: (1) the condition of the underlying lung at the time of the appearance of the empyema; (2) the clinical type of the infection; (3) the treatment prior to the development of empyema; (4) the bacteriology of the pus; and (5) the treatment and results. Sayago and Lastra have reported the work of this Committee. In some detail they studied 82 cases. Aspiration with or without lavage was used in 41 patients and of this group 16 (39 per cent) were cured, 11 (26.8 per cent) were benefited, 7 (17.1 per cent) became worse, and 7 (17.1 per cent) died. Thoracoplasty was done in 17 cases with 6 cures (35.3 per cent) and 8 deaths (47.1 per cent); 3 patients were better but not cured.

Smart found that among 4,500 patients with pulmonary tuberculosis in Olive View Sanatorium, 71 had tuberculous empyema and 23 of these had superimposed pyogenic infection. Of the 48 patients with pure tuberculous empyema, 14 were cured, 12 benefited, 1 was worse, and 21 died. Of the 23 with mixed infection, 10 were cured, 3 benefited, and 10 died. In the former group 11 had no particular treatment and of these 9 died, 1 was cured, and 1 benefited; 26 were treated by aspiration with or without a modifying solution and 6 were cured, 9 benefited, 1 was worse, and 10 died. In this same pure tuberculous group 4 were treated by open drainage and of these 2 died and 2 were cured; 1 was cured by aspiration and interruption of the phrenic nerve. Six had thoracoplasty and 4 of these were cured and 2 benefited. Of the 23 patients with mixed infected empyema, 1 had no treatment and died; 9 had aspiration and 5 of these were cured, 2 were benefited, and 2 died. Eight had open drainage; 6 died and 2 were cured. Thoracoplasty was done in 5 with 1 death and 4 cures. Smart believes that in all cases active treatment is essential since the mortality is very high without some form of treatment.

TABLE VI.—112 CASES OF TUBERCULOUS EMPYEMA (SKAVLEM)

Type of treatment	No. of cases	Recovered		Improved or under treatment		Deaths	
		Cases	Per cent	Cases	Per cent	Cases	Per cent
Indifferent	41	0		1	2.4	40	97.6
Thoracotomy	7	0		2	28.6	5	71.4
Oleothorax	40	13	32.5	13	32.5	14	35.0
Thoracoplasty	24	14	58.3	7	29.2	3	12.5

Skavlem and his associates have critically analyzed 112 consecutive cases of tuberculous empyema which they have had under their care. They have divided treatment into three groups: (1) indifferent—chiefly bed rest, opiates, and an occasional thoracentesis; (2) oleothorax with 5 per cent gomenol in olive oil; and (3) surgical treatment—thoracoplasty, drainage, and interruption of the phrenic nerve. They believe that extrapleural thoracoplasty is the most satisfactory form of treatment. Their results are tabulated in Table VI.

Taylor has reported on 79 patients with tuberculous empyema; of this number 25 were cured (31.6 per cent), 46 died (58.2 per cent) and 8 were not traced. Aspiration with and without pleural lavage was used in 55 with a mortality of 52.6 per cent. Eleven patients in rather poor condition were treated by drainage, with a mortality of 63.6 per cent. Thoracoplasty was used in 13, of whom 4 (30.8 per cent) died. Taylor believes that thoracoplasty is one of the most valuable methods of treatment and has made the outlook in individual cases more favorable.

Trail believes that in pure tuberculous empyema aspiration with air replacement is the best treatment. The air introduced should be in decreasing amounts in order to allow re-expansion of the lung. This should then be followed by an extrapleural thoracoplasty in almost all cases. The prognosis for secondarily infected tuberculous empyema is no worse than for the pure type. In all cases of tuberculous empyema major surgery, namely thoracoplasty, is by all odds the treatment of choice. Trail states, " . . . while a predominantly tuberculous infection *may* warrant conservative treatment, a predominantly secondary infection or an underlying lesion which renders the empyema a secondary consideration demands major surgery."

Woodruff has studied 184 cases of tuberculous empyema, 112 of which were without secondary infection and 42 of which had mixed tuberculous and pyogenic empyema; in the remainder the type of infection is not stated. Bronchopleural fistula was known to exist in 47 patients and of this number 30 (63.8 per cent) died. The results of the various treatments used are shown in Table VII.

It is significant that at the time Woodruff reported this series of patients 50 were known to be well and working. Among these the lung had re-expanded in 14, 12 had had thoracoplasty, 8 had had oleothorax, and the remaining 16 had pneumothorax with or without residual pus. Only 7 of the 42 patients with secondary infection were well and working; of these 5 had had thoracoplasty, 1 had a re-expanded lung, and 1 still had a small empyema.

Berry has reported 75 cases with mixed tuberculous empyema; in 49 of these the sputum was positive and in the others the diagnosis of tuberculous empyema was based on the presence of tubercle bacilli in the pleural fluid, tubercles in the pleura, or roentgenographic evidence of tuberculosis. The results of treatment by various methods may be seen in Table VIII. In all of these cases there was superimposed pyogenic infection. Berry urges that thoracoplasty be performed in every patient just as soon as sepsis has been controlled by means of drainage or pleural lavage.

In determination of the value of thoracoplasty relative to other methods of treatment, certain factors must be considered. Those who disbelieve the efficacy of thoracoplasty will discount the results by claiming that all patients who are thus operated upon form a highly selected group, and that, in effect, only those who have strong natural resistance will be operated upon. The detractors will also claim that other and more simple methods of treatment are used in those patients for whom thoracoplasty is contraindicated, in desperately ill patients, and even in those who are almost moribund when treatment is instituted. These things are true. However, the fact that they are true is evidence that methods of treatment of tuberculous empyema are still not very good. Let it be remembered that many patients who die of tuberculous empyema could

TABLE VII.—184 CASES OF TUBERCULOUS AND MIXED INFECTED EMPYEMA (WOODRUFF)

Type of treatment	No. of cases	Cured		Improved		Unimproved or worse		Deaths	
		No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
No treatment	6	2	33	2	33			2	33
Aspiration	46	16	35	9	19			21	46
Aspiration and chemicals and dyes	50*	7	14	9	18			34	68
Oleothorax	29†	12	41	5	18			12	41
Drainage	25‡	1	4			5	20	19	76
Thoracoplasty	28	12	43	9	32			7	25
Totals	184	50	27	34	18	5	3	95	52

*26 additional cases required further treatment and are included in the appropriate groups.
†6 additional cases required further treatment and are included in the appropriate groups.
‡8 additional cases required further treatment and are included in the appropriate groups.

at one time in the course of the disease have had an extrapleural thoracoplasty with a good chance of being cured.

On the other hand every thoracic surgeon is asked to operate (and does so) upon many patients with tuberculous empyema who are by no means good surgical risks. In these cases, and with the knowledge of all concerned, operation is undertaken since it is the only remaining hope for the patient. Death as a direct or indirect result of thoracoplasty is inevitable for many such patients.

This review is not a proper medium for precise description of surgical procedures used in the treatment of tuberculous empyema. Extrapleural thoracoplasty is the most effective operation that is used. This, supplemented by a partial Schede operation, if necessary, or phrenic-nerve interruption to close a small residual pleural cavity, will be of greatest avail. Drainage by rib resection or intercostal catheter is seldom necessary and is probably advisable only in those cases with severe constitutional symptoms, with severe secondary infection or with significant bronchopleural fistulas. Excellent discussion of the usefulness of these operations and detailed exposition of the techniques employed are in Alexander's book, "The Collapse Therapy of Pulmonary Tuberculosis."

Sergent and Iselin advise the following plan of treatment of all cases of tuberculous empyema with secondary pyogenic infection: (1) open drainage with resection of long segments of 2 or 3 ribs; (2) extrapleural thoracoplasty with adequate formalinization of the periosteum of the resected ribs, and (3) partial pleurectomy to unroof the small residual cavity. These authors also believe that the above method of treatment should be used whenever severe fever is a feature in pure tuberculous empyema.

Other French surgeons, notably Fruchaud and Bernou, and Monod have made good use of this surgical plan of pleurotomy for drainage, extrapleural thoracoplasty to approximate the parietal and visceral pleural layers, and partial pleurectomy to unroof the small remaining cavity and completely cure the empyema. The first step may be omitted and the thoracoplasty done at once in those cases without serious secondary infection or severe general symptoms from pure tuberculous empyema. Pleurectomy may not be necessary if the thoracoplasty and supplementary diaphragmatic paralysis completely close the cavity. Monod has emphasized that it is often unwise to delay starting a thoracoplasty in those patients who are seriously ill; he believes that thoracoplasty often causes astonishing symptomatic improvement in these patients.

TABLE VIII.—75 CASES OF MIXED TUBERCULOUS EMPYEMA (BERRY)

Type of treatment	No. of cases	Cured	Improved	Unimproved	Under treat.	Deaths	Cases lost
Aspiration	13					11	2
Aspiration and irrigation	13	4	1		3	5	
Aspiration, irrigation and thoracotomy	20	2	2	4		12	
Thoracoplasty	29	9	1		3	14	2
Totals	75	15	4	4	6	42	4

Haight has written of the importance of aspirating air from a tuberculous pyopneumothorax at the time the thoracoplasty is done. He has emphasized the need for removing enough air to allow the chest wall to fall inward. It may be desirable and possible to eliminate the pneumothorax entirely after the first stage of a thoracoplasty. Bettman has also insisted upon the necessity of removing air and fluid. He has found that after a thoracoplasty in the presence of pyopneumothorax, retained air or fluid, or both, will prevent the proper collapse of the chest wall or will cause a possibly distressing mediastinal displacement. Bettman believes it is important to remove even small amounts of air or fluid at the time of operation. His method is to insert a trocar into the pleural cavity well away from the operative wound and, while the wound is still open after the ribs have been resected, to exert manual pressure on the chest wall to a degree comparable to that which is expected as a result of the operation. This pressure will force air and fluid out of the trocar which is then withdrawn. The same result can be effected by aspiration of air and fluid, or both, at the end of the operation.

Van Allen has recognized the importance of preventing regeneration of the ribs between stages of an extrapleural or Estlander thoracoplasty for tuberculous empyema. He has used Zenker's solution and 10 per cent formalin, and has found the latter to be more effective and less likely to cause sloughing. Jachia, however, prefers to treat the periosteum of the resected ribs with Zenker's solution. Alexander has long used 10 per cent formalin to prevent or at least retard regeneration of the ribs in all extrapleural thoracoplasties and has found it very effective.

Apart from the modern extrapleural thoracoplasty to effect closure of an empyema cavity, certain other operations have been suggested. Interruption of the phrenic nerve to produce paralysis and rise of the hemidiaphragm is often effective in reducing the size of an empyema cavity and when used in conjunction with thoracoplasty enables one to resect fewer ribs than might otherwise be necessary.

Monaldi has described an operation which he calls "anterolateral elastic thoracoplasty." In this procedure anterolateral segments of the first to the seventh ribs are removed, thereby allowing that side of the chest wall to share less in respiration and the remaining rib segments to contract.

External drainage. Open or closed drainage of tuberculous empyema remains a controversial subject. Most authors agree that drainage is usually necessary when the pus contains pyogenic organisms as well as tubercle bacilli. As with non-tuberculous empyema, there are staunch supporters of draining by intercostal catheter and equally valiant exponents of the need for resecting a rib to provide adequate drainage. Any method that will provide complete and dependent drainage without the necessity for complicated apparatus may be used. It is my belief that rib resection best fills the requirements. It must be remembered that the patient who requires drainage of a tuberculous empyema will almost certainly need a subsequent thoracoplasty. Therefore the drainage opening should be as far as possible from the proposed site of the inevitable thoracoplasty in order to avoid infection of the wound; however, adequately dependent drainage must not thereby be sacrificed.

Eloesser has described a new operation for the drainage of tuberculous empyema. This consists in mobilizing a U-shaped skin flap and sewing the free end of this to the parietal pleura after resection of a segment of rib. This method obviates the necessity of using a rubber drainage tube which may act as a foreign body and perpetuate secondary infection. Eloesser has found that such a wound remains open until the lung reaches the chest wall and then spontaneously closes. He does not advise its use in those empyemas in which the lung is so badly infected that reexpansion is inadvisable.

It is well recognized that surgical drainage of tuberculous empyema with superimposed pyogenic infection is necessary in most cases. Whether this drainage is effected by rib resection or intercostal catheter is not at the moment germane.

Drainage of pure tuberculous empyema enjoys no such unanimous approval. Indeed this method of treatment has been most heartily condemned. Alexander believes that drainage should never be done for pure tuberculous empyema. Keller has called surgical drainage "the greatest tragedy that can befall the tuberculous empyema patient with sterile exudate." MacDonald believes that drainage of pure tuberculous empyema is always a great tragedy. The American Sanatorium Association through the report of its Committee on the Treatment of Tuberculous Empyema warns that closed or open drainage of purely tuberculous empyema is never warranted since pyogenic superinfection will thereby at once be introduced. Such warnings are repeated in many other articles dealing with tuberculous empyema. It is necessary and just that the dangers resultant from drainage of pure tuberculous empyema should be emphasized and reiterated. Certainly

TABLE IX.—ADDITIONAL REPORTS OF 20 OR MORE CASES OF TUBERCULOUS EMPYEMA, 1930–1941

Author	Treatment	No. of cases	Cured		Improved		Unimproved or worse		Deaths	
			No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Archibald	Drainage	12*			4	33	1	9	7	58
	Thoracoplasty	24	9	36	11	44	1	4	3	12
Beninato	Aspiration and lavage	52	29	56			23	44		
Bernou and Fruchaud	Intrapleural suction and lavage and thoracoplasty	21	7	33	8	38	3	14	3	14
	Thoracoplasty	30*	11	37	8	27			11	37
Brock, Mullen and Woodson	Aspiration	62	27	44	4	6	16	26	15	24
	Aspiration and chemicals	62	28	45	11	18	4	6	19	31
Carmichael	Oleothorax	20	9	45	4	20	3	15	4	20
Dumarest and Rougy	Pleurotomy	33	12**	36	11	33	3	9	7	21
Fruchaud and Bernou	Thoracoplasty	95	48	51	19	20			28	29
Gaetan and Smith	Aspiration	22			15***	68			7	32
	Drainage	8			6	75			2	25
	Thoracoplasty	6	5	83	1	17				
Jones and Alexander†	Aspiration, with or without chemicals	5							5	100
	Drainage	21	6	28	2	10	2	10	11	52
	Phrenic interruption	1	1	100						
	Thoracoplasty	43‡	33	77	2	5	1	2	7	16
Jonsson	Aspiration	64	27	42	2	3			35	55
	Aspiration or drainage	11	3	27					8	73
	Thoracoplasty	5	3	60					2	40
Mourier	Aspiration	15	8	53			7	47		
	Oleothorax	3			1	33			2	67
	Thoracoplasty	6	5	83					1	17
Nylander	Drainage	20			2	10			18	90
	Thoracoplasty	21	8	38	8	38			5	24
Peters and associates††	Aspiration	70	17	24	18	26	13	19	22	31
	Drainage	212	38	18	50	24	20	9	104	49
	Thoracoplasty	132	21	16	54	41	17	13	40	30
Pissary (Collected)	Aspiration	15	2	13	1	7	1	7	11	73
	Oleothorax	20			5	25	2	10	13	65
	Drainage	17	2	12	4	23			11	65
	Thoracoplasty	17	4	24	6	35			7	41
Rosenblatt	Aspiration and chemicals	21	11	52					10	48
Sayago and Lastra	Aspiration with or without lavage	41	16	39	11	27	7	17	7	17
	Oleothorax	7	1	14	2	29			4	57
	Phrenic interruption	11	3	27	2	18			6	55
	Thoracoplasty	17	6	35	3	18			8	47
Secrétan	Anterolateral thoracoplasty and forced suction	30	21	70	5	17	4	13		
Smart	Aspiration with or without chemicals	36	12	33	11	31	1	3	12	33
	No treatment	12	1	8	1	8			10	83
	Drainage	12	3	25	1	8			8	67
	Thoracoplasty	11	8	73	2	18			1	9

*All had mixed infection.
**Four had thoracoplasty.
***All waiting for thoracoplasty.
†Same cases reported in Tables III, IV, and V.
‡All had phrenic interruption.
††For The American Sanatorium Association.

carelessly inadvertent drainage of empyema without recognition of its possibly tuberculous nature deserves condemnation.

It is true that the results of drainage in most hands are bad, mortality is high, and cures are few. Most of us have drained a chronic empyema by rib resection without thinking it might be tuberculous or without being able to demonstrate its tuberculous nature before operation. Most of us have been deeply impressed by the tragic ends

that have ensued and have been helpless to control secondary pyogenic infection. These cases are sufficient deterrents against carelessly undertaken drainage of tuberculous empyema. Just as often, I believe, the tragedy of drainage results from reactivation of pulmonary tuberculosis which was similarly not recognized.

There is another view that deserves consideration. There are patients with pure tuberculous empyema that require surgical drainage. The French often speak of "malignant tuberculous empyema" which is characterized by high fever, marked systemic effects, and rapid reaccumulation of pus even with frequent aspirations. Pyogenic infection does not play a recognizable part in such cases. Aspiration with or without pleural lavage should be tried but will frequently prove useless. Thoracoplasty should be considered but is frequently impossible because of the patient's poor condition. Surgical drainage is the only remaining effective means of treating such a malign infection.

There are many cases of tuberculous empyema with significant bronchopleural fistulas that never have pyogenic superinfection. It is a mistake to assume that bronchopleural fistula in tuberculous empyema necessarily means that pyogenic organisms have invaded the pleural cavity. In his discussion of Woodruff's paper, Rogers said that of 20 patients with bronchopleural fistulas, 7 never had secondary pyogenic infection. Despite the fact that secondary infection does not always complicate tuberculous empyema with a bronchopleural fistula, external drainage is sometimes necessary and desirable to keep the pleural cavity free from pus. In the presence of a bronchopleural fistula pleural pus constantly menaces the patient with bronchial spread of the tuberculosis.

Because of this omnipresent danger, Bernou, Fruchaud, and Marécaux believe that drainage should always precede a thoracoplasty that is to be done for tuberculous empyema. These same authors believe that pure tuberculous empyema with accompanying severe toxemia should be treated by surgical drainage followed by thoracoplasty and partial pleurectomy if necessary. Dumarest and Pavie have found that clinical experience does not support the great fear of secondary infection of a tuberculous empyema in the presence of a pleurotomy. They believe that if drainage is satisfactory, secondary infection does not occur, and that even infection with organisms such as staphylococci is of no great importance. These authors have reported 39 cases of pure tuberculous empyema treated by open drainage; in 5 of these the pleurocutaneous fistula closed by complete pleural symphysis, and in 3 the drainage opening closed and left a partial pneumothorax. They believe that drainage prevents contralateral spread of the tuberculosis and encourages healing of bronchopleural fistulas. Far from believing that pleurotomy is contraindicated for pure tuberculous empyema, Dumarest and his associates aver that it should be used more frequently, especially in the presence of intermittent or latent bronchopleural fistulas. They have reported cures or great improvement in 72 per cent of the patients so treated.

Ornstein and Ulmar agree that thoracotomy should be done when pure tuberculous empyema is complicated by a bronchopleural fistula of appreciable size; the thoracotomy should be followed by thoracoplasty. Nicklas, Franklin, and Zavod have expressed the opinion that empyema with bronchopleural fistula should be treated by external drainage regardless of whether organisms other than tubercle bacilli can be found in the pus. This same opinion is shared by Proctor.

Renaud and Miget think that drainage by means of an intercostal catheter is the simplest and most efficacious method of treatment of tuberculous empyema. Rudenko, following the precepts of Rose, has advocated open drainage of tuberculous empyema; after several months of drainage thoracoplasty is done. Rudenko has reported 7 cases and of these 6 have been cured and 1 is greatly improved. He has demonstrated that, after open drainage, pleural biopsies will reveal that tubercles gradually disappear from the pleura in about four months and leave only a pyogenic reaction. The Argentine Committee for the Study of Tuberculous Empyema has advised external drainage whenever aspiration and lavage are not effective in controlling the infection. Others have agreed that drainage is a valuable preliminary to thoracoplasty; by this method they believe that the patient's general condition may be greatly improved.

If surgical drainage is advisable in the treatment of tuberculous empyema, some consideration must be given the available methods of providing it. It is my belief that tuberculous empyema with significant pyogenic infection requires open drainage. In a previous paper on non-tuberculous empyema I have detailed reasons for this belief and these arguments are equally valid in respect to mixed tuberculous infection. Eloesser's operation to provide adequate drainage without the use of a tube is a useful procedure. Sergent and Iselin advise that mixed tuberculous empyema should be drained by the resection of 12 cm. of two or three ribs and the underlying pleura.

Toussaint suggests that pure tuberculous empyema should be drained by an air-tight method; this may be accomplished either by means of an intercostal catheter or by rib resection. If the latter method is used, Toussaint advises that the drainage track enter the pleura at an oblique angle. This may be accomplished by raising a U-shaped skin flap extending over two ribs and then resecting the upper rib; the pleura is opened through the bed of the resected rib; a drainage tube is inserted and the skin flap sutured over the tube which is connected to an air-tight drainage system.

Franklin has described a method of treatment of tuberculous empyema by means of drainage through the second anterior interspace. A drainage tube reaching the bottom of the pleural cavity and an irrigating tube are inserted through this opening and connected to a suction-irrigation system. Franklin believes that this method allows more exact control of the intrapleural pressure, prevents the leakage of pus around the drainage tube, and causes the patient less discomfort.

Aznarez uses an intercostal catheter connected to a suction system that enables him to use negative pressures up to minus 50 cm. of water. Hart advocates the use of a tidal irrigation system by means of which it is possible to obtain almost any degree of suction or even intrapleural compression.

Happily there are few who do not agree that adequate external drainage is essential in mixed tuberculous and pyogenic empyema. Drainage of pure tuberculous empyema will probably continue to be a matter of necessity rather than of choice. That necessity is imposed when spread of tuberculosis is threatened because of bronchopleural fistulas, when pus rapidly re-accumulates after aspiration, and when other treatment fails to relieve severe toxicity.

Operative procedures other than drainage, phrenic-nerve interruption, extrapleural thoracoplasty, and partial pleurectomy, occasionally become necessary. Bethune has reported 3 cases of tuberculous empyema with bronchopleural and pleurocutaneous fistulas; each of the patients has been treated with maggots and Bethune has believed the results were good. He has found that maggots will ingest living tubercle bacilli since the organisms have been found in the guts of the larvæ.

Jaquerod has reported 2 interesting cases of persistent tuberculous empyema. One of these was operated upon in 1910 by an unknown Viennese surgeon. He removed the entire left thoracic wall: skin, muscles, periosteum, ribs, and parietal pleura. This left a large open wound with the visceral pleura on a completely collapsed lung as the external layer. Healing eventually took place by fibrosis and epithelization. The second patient was operated upon in 1913 by Vulliet and a similar operation was done. It is suggested that such an operation may be useful in certain tuberculous empyemas that cannot otherwise be cured. Plastic operations to close residual empyema cavities may be necessary and pedicle flaps of available muscles may be used. Pool and Garlock have suggested using muscle flaps to close persistent bronchopleural fistulas.

EMPYEMA NECESSITATIS

It is sometimes difficult to differentiate empyema necessitatis from tuberculosis of the chest wall or extrapleural tuberculous cold abscesses. In the former case the presence of tuberculous pus external to the ribs is the result of increased intrapleural pressure forcing the pus into the soft tissues of the chest wall. Tuberculous parietitis or cold abscesses of the chest wall, however, are in reality metastatic infections that arise by lymphatic extension of the disease of the pleura. In the presence of tuberculous empyema a soft-tissue abscess of the chest wall may be true empyema necessitatis or it may be a separate focus of infection for which the empyema has provided a source of bacilli.

Empyema necessitatis is, in effect, spontaneous drainage of the pus by direct perforation of the parietal pleura. It is a natural result of a pressing need for evacuation of the pus. It is my belief that it is of less frequent occurrence than is the extension of the tuberculosis from the pleura to the receptive lymph nodes. True empyema necessitatis should take place only at points of greatest pressure or at sites of weakness of the supporting muscles of the chest wall. Since the force of gravity should play an important part in direct perforation of the pleura, empyema necessitatis should point at dependent places—in the postero-inferior portions of the chest. However, this site is rather infrequently involved. More frequently soft-tissue abscesses are found in the anterolateral portions of the chest.

Burke has studied the lymphatic drainage of the parietal pleura in an effort to determine the route of infection. He has found substantially the same lymphatic drainage that was demonstrated by Souligoux in 1894. According to Burke, Souligoux found lymph channels in pleuritic adhesions and also found that parasternal lymph nodes in patients with pulmonary tuber-

culosis and tuberculous empyema are frequently large and caseous. Kaufman has produced evidence that most spontaneous abscesses of the chest wall originate in caseous parasternal lymph nodes. Burke has studied the problem by work on experimental animals and also by the examination of cadavers. Ten guinea pigs were injected with thorium dioxide and lamp black mixture and deposits of the mixture were found in both pleural spaces in every animal. The mixture was regularly conveyed to two groups of lymph nodes, the parasternal nodes and a cluster of retroperitoneal lymph nodes close to the descending aorta at the level of the lower thoracic or upper lumbar vertebrae. Such intrapleural particulate matter was rarely, if ever, transported to the tracheobronchial or paratracheal lymph nodes. In rabbits the mixture was conveyed only to the parasternal lymph nodes on the injected side and apparently not to the retroperitoneal nodes. When tubercle bacilli were injected intrapleurally into vaccinated guinea pigs the organisms were transported at least in part to the parasternal and para-aortic lymph nodes where they produced typical tuberculous lesions. Guinea pigs injected with 0.1 mgm. of tubercle bacilli developed pleural adhesions in most cases. The tracheobronchial and paratracheal lymph nodes were not invaded by the tubercle bacilli.

In the second part of Burke's study 49 cadavers were examined. Eighteen of these presented no signs of pleurisy and 31 had had pleuritis of varying degrees. In 18 cadavers a search was made for parasternal lymph nodes only. Twelve of these had no pulmonary or pleural lesions and in these the parasternal nodes were minute (1 to 2 mm. in diameter). Six of the cadavers had pulmonary tuberculosis and localized or widespread plastic pleuritis. In these the parasternal lymph nodes were large (0.5 to 3 cm. in diameter) and tuberculous. Those with extensive pleuritis had larger parasternal nodes than those with localized pleuritis. In 31 cadavers a search was made for other enlarged lymph nodes. Six of these had no pulmonary or pleural disease; 25 had pleuritis of varying degrees. The 6 with no thoracic disease had very small parasternal lymph nodes in the second intercostal spaces; in 1 case a small cluster of small nodes was found in the retroperitoneal space near the vertebral attachments of the diaphragmatic crura. In the 25 cadavers in which pleuritis was found the parasternal lymph nodes were all abnormally large. Large nodes were found most frequently in the first and second interspaces but did occur in all interspaces from the first to the sixth. These enlarged nodes were invariably tuberculous and some were caseous. In 10 of the 25 cadavers enlarged tuberculous nodes were found in the retroperitoneal space near the vertebral attachments of the diaphragmatic crura.

Supported by these observations, Burke suggests that pleuritis is very frequently associated with tuberculosis of the parasternal lymph nodes and occasionally with involvement of the para-aortic nodes. Since in experimental animals the particulate matter is transported to the parasternal nodes within a day or two, it is probable that existing lymph channels effect the transfer. The communication of the pleural lymphatics with retroperitoneal lymph nodes around the last thoracic and first lumbar vertebrae has not been emphasized in the past.

Burke thinks that a spontaneous cold abscess of the chest wall probably evolves as follows: tubercle bacilli invade the pleural space and set up a local or widespread pleuritis. Some of these bacilli are carried from the pleura to the parasternal lymph nodes which become caseous and rupture, and thus form a cold abscess of the chest wall.

Pinner and Moerke quote the experiments of Dybkowski, Flanier, and others who showed that resorption of material from the pleura takes place largely through lymph channels in the costal pleura.

Maurer, Rolland, and Roux have reported the histories of 10 patients who developed infections of the chest wall subsequent to tuberculous empyema. These authors believe that a certain number of patients with artificial pneumothorax and empyema develop infections of the chest wall. One such group of patients will usually have artificial pneumothorax for pulmonary tuberculosis and suddenly develop severe tuberculous empyema. Even after adequate dependent drainage of the empyema there will suddenly develop an infection of the chest wall without immediate communication between the abscess and the pleural cavity, although this may occur later. The infection may involve the soft tissue and bones. In a second group the parietal infection occurs more slowly and the abscess appears a long time after the pleurotomy has been done. In a third group infection of the chest wall may take place long after pleurotomy and thoracoplasty has been done for empyema. These abscesses of the chest wall are pleurogenic in origin, the route of infection being through the lymphatics. In almost all cases the abscess appears in the anterior chest wall at the level of the second intercostal space. This particular fact was known

as far back as 1829 when it was described by Cruveilher. These parietal suppurations develop by lymphatic drainage and are not a simple penetration of pus from pleural collections. This latter mode of infection is ruled out by the fact that the abscesses never occur at the most dependent point of the empyema. Furthermore, abscesses of the chest wall may develop long after satisfactory dependent drainage of the empyema has been done, and they do not always communicate with the empyema cavity. Maurer and his associates think that if febrile episodes occur in a patient with empyema and satisfactory drainage, a point of tenderness should always be sought at the second anterior interspace.

Cascelli has reported the history of a patient with tuberculous pleural effusion who developed a tumor of the anterior chest wall at the level of the fifth rib. This was found to communicate with the pleural cavity. Many months later roentgenograms of the chest disclosed calcification of the pleura and of the chest-wall abscess. Cascelli believes that the infection of the chest wall resulted from invasion of the lymphatics and lymph nodes of the intercostal space by bacilli from the pleural fluid. According to Taddei (as quoted by Cascelli) peripleural and parietal cold abscesses may originate in the following ways: (1) by extension of infection through the subpleural lymphatics; (2) by involvement of the lymph nodes of the intercostal spaces; (3) by direct extension of empyema in peripleural connective tissue after ulceration of the pleura; and (4) from tuberculosis of the rib, costal cartilage, or vertebral bodies.

In the case reported by Terzani, a patient with a serohemorrhagic tuberculous pleural effusion developed a cold abscess posteriorly at the level of the ninth to eleventh ribs. This communicated with the pleural cavity and developed despite repeated aspirations of fluid through the seventh and eighth interspaces in the midaxillary line.

Constantinescu has reported 2 cases of tuberculous abscesses of the chest wall following tuberculous empyema. In each of these cases the abscess appeared in the first and second interspaces in the anterior axillary line.

Apart from complications of empyema that are manifestly due to concurrent infections of the lymphatic channels and lymph nodes of the chest wall, there are also direct perforations of the chest wall or neighboring structures by pus from the pleural cavity. Arnstein has reported 1 case of his own and 4 similar ones from the literature of "pyopneumothorax necessitatis." Each of these patients developed a chest wall abscess containing air and pus as a complication of tuberculous empyema in an ineffective pneumothorax. All of these cases occurred on the left side; 2 perforated at the sites of needle punctures and in the remaining 3 the probable cause of the air-filled abscess of the chest wall was the perforation of an infected lymph node into the pleural cavity. In all of these cases the intrapleural pressures were highly positive and the conditions simulated those of an undrained empyema. Arnstein suggests that the more frequent occurrence of this complication on the left side may be due to the lesser volume and different configuration of the left hemithorax. Paillard has reported a rather similar case. Her patient developed a parapneumothoracic tuberculous empyema on the left. Treatment was carried out by repeated aspirations but the intrapleural pressures remained as high as plus 32 cm. of water. Empyema necessitatis developed with an abscess in the chest wall over the second to fourth interspaces in the midclavicular line. On fluoroscopy the level of fluid in the pleural cavity pulsated synchronously with the heart and the same rhythm could be observed in the abscess of the chest wall. This type of pulsating pyopneumothorax is observed only on the left side. Emery has described a quite similar case.

Perforation of pus from tuberculous empyema may also occur into the esophagus as in the case described by Kanter and Madoff. In their patient an esophagopleural fistula resulted from spontaneous tuberculous pyopneumothorax. At autopsy a fistula between the middle third of the esophagus and the right empyema cavity was found; the track was lined by tuberculous granulation tissue. Valli has also reported the case history of a patient with parapneumothoracic empyema for which open drainage was provided. Four years later, with the parietal fistula still open, she developed a pleuro-esophageal fistula which was recognized roentgenologically by the ingestion of barium, part of which passed directly into the stomach while another part entered the pleural cavity. At post-mortem examination a 3 mm. perforation of the esophagus was found at the level of the tracheal bifurcation. It is, I think, quite feasible to effect surgical closure of such a fistula provided the patient's condition is sufficiently good to warrant undertaking the procedure and provided other manifestations of tuberculosis do not make the outlook hopeless anyway. If transthoracic closure of the fistula is not possible, it may be necessary to do a gastrostomy in order to divert food from the pleural cavity. I dare say successful closures of such

esophagopleural fistulas by transthoracic suture will soon be reported.

Pus from within the pleural cavity may point in other parts of the body. Clemente has described the case of a patient with tuberculous pleurisy and effusion who developed a tuberculous abscess of the epigastric region of the abdominal wall. It is Clemente's belief that the infection traversed the diaphragm and extended through the peripleural and periperitoneal connective tissue to a subcutaneous site in the abdominal wall. In the case reported by Roback and Alley, tuberculous peritonitis was followed by a subphrenic abscess which in turn perforated the diaphragm and produced tuberculous empyema.

Sindel has reviewed 245 cases of tuberculous empyema in Sea View Hospital. Of this number 24 (10 per cent) developed abscesses of the chest wall. Ten (4 per cent) had pleurocutaneous fistulas, and 59 (24 per cent) developed empyema necessitatis. The actual existence of a communication between the pleural cavity and the parietal wall or neighboring wall was proved by means of roentgenograms taken after the injection of lipiodol, or by the identification in one site of methylene blue that had been injected into the other, or by mechanical methods. In some of Sindel's cases aspiration of pus from the pleural space completely reduced the abscess of the chest wall, and in others the injection of air into the pleural space was followed by the appearance of air in the abscess. In this series of 59 cases, 58 of the abscesses appeared in the chest wall and 1 in the lumbar region: 35 were of pure tuberculous infection (59 per cent) and in 24 (41 per cent) tubercle bacilli and pyogenic organisms were identified. In 57 cases empyema necessitatis followed parapneumothoracic tuberculous empyema and in all cases the pus was thick. Bronchopleural fistulas were demonstrated by the expectoration of injected methylene blue in 30 cases (51 per cent). Although a large number of Sindel's cases occurred at the sites of needle punctures for aspiration of pus, he found that the number of aspirations had little effect upon the development of empyema necessitatis.

In 73 per cent of Sindel's cases perforation of the parietal pleura occurred anteriorly between the second and sixth ribs from the parasternal to the anterior axillary lines and most commonly between the anterior axillary and midclavicular lines. It is Sindel's belief that this is true because most empyemas occur anteriorly, and that infection of lymph nodes and subsequent perforation of a caseous node into the pleural cavity is not a rational explanation of the development of these chest-wall abscesses. However, in Sindel's own group of cases the empyema was general in 68 per cent. It is difficult to accept his belief that perforation occurs by mechanical causes. Indeed, I believe his own figures support the belief that chest-wall abscesses and empyema necessitatis in the presence of tuberculous empyema are, in the majority of cases, caused by lymphadenitis.

Sindel has reported the mortality in his own group of 59 cases and in an additional 122 cases collected from the literature. Among these 181 cases the mortality rate was about 50 per cent. Of his own group of 59 patients, 50 died, 5 were cured, and 2 are living but not cured; the remaining 2 have not been traced.

MacDonald found 2 cases of empyema necessitatis among 15 of mixed infected tuberculous empyema.

The essence of treatment of empyema necessitatis is prevention by prompt and adequate treatment of the underlying empyema. However, once a communicating chest-wall abscess has developed, evacuation of the pleural pus is imperative to prevent further spread and to forestall the development of a pleurocutaneous fistula in an undesirable site. For this reason surgical drainage is often necessary.

CONCLUSIONS

It is possible to state certain conclusions that have acquired their strength from the papers read in preparing this review and from my own experience.

1. Tuberculous empyema is a frequently occurring complication of artificial pneumothorax used in the treatment of pulmonary tuberculosis.

2. Tuberculous empyema is caused by tubercle bacilli which reach the pleural space usually by the rupture of pulmonary foci of infection.

3. Tuberculous empyema is to a great extent preventable or avoidable. Prevention depends upon the proper selection of cases for artificial pneumothorax, the early division of visceroparietal adhesions that prevent effective collapse of the lung under treatment, and the early abandonment of an ineffective pneumothorax that cannot be made efficient by the division of adhesions.

4. Tuberculous empyema is still rather badly treated. Consequently the mortality rate of 33 per cent is much too high.

5. Treatment should be started when an infected effusion first appears in a pneumothorax. There is no wisdom in a policy of "watchful waiting" or "skillful neglect."

6. Tuberculous empyema heals by the progressive growth of adhesions between the pleural layers. Therefore any method of treatment that does not produce obliteration of the pleural space must be considered of temporary value even though permanent cures are sometimes thereby obtained.

7. Simpler methods of treatment such as aspiration and pleural lavage are often effective and are especially valuable since the therapeutic pneumothorax may be maintained. If such methods do not promptly alleviate the patient's symptoms, sterilize the fluid and prevent its further formation, then surgical methods should be used.

8. There is no available drug or chemical that will effectively and safely destroy the tubercle bacillus in the human body.

9. Extrapleural thoracoplasty with or without external drainage of the empyema cavity has produced the greatest number of cures of tuberculous empyema with the lowest mortality.

10. External surgical drainage is an essential treatment of tuberculous empyema with secondary pyogenic infection. Surgical drainage of pure tuberculous empyema may be necessary when pulmonary spread of tuberculosis is threatened because of bronchopleural fistulas, when pus re-accumulates very rapidly, and when other treatment fails to alleviate severe toxicity.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

HEAD

Hofrath, H.: A Contribution to the Surgical-Orthopedic Management of Maxillofacial Wounds (Ein Beitrag zur chirurgisch-orthopadischen Behandlung der Gesichts-Kieferverletzungen). *Deutsche zahnaerztl. Wchnschr.*, 1941, p. 31.

In the introductory remarks of this treatise Hofrath refers to the "Manual" of Lindemann, and in the body of his paper he also makes references to that author.

Hofrath asserts that it is advantageous to turn over the orthopedic management of gunshot fractures of the jaw to special hospital units. Until the patients arrive there, in many cases a simple bandage splint will be sufficient for their transport. Extra-oral splinting is achieved with plaster bandages, light metal, or sheet metal, in accordance with Lindemann's manual. Intra-oral splinting is employed for the replacement of fractured fragments to their normal position. For combating pain, aside from the anesthesia of the initial reduction, the use of Lindemann's nerve-block with alcohol-novocaine is most effective. Hofrath believes that one loses nothing if the final orthopedic treatment is instituted after two or even three weeks. Regional anesthesia by nerve-block appears to be most effective in combination with a form of twilight-sleep obtained with scopolamine-eukodal-ephetonin.

Only splinting by means of wire with soldered ring-bands, which are prepared from cast models in the laboratory by the indirect method, is designated as final fixation. Malar fractures are reduced with a pronged hook and held in place with a special retention apparatus. With toothless fracture-fragments, bone suture, which is to be avoided otherwise, may be employed; in these cases Lindemann recommends approximation by means of wire brackets. Absolute fixation is dependent on the formation of adequate regeneration tissue. By means of approximation of the fixation bridge, which can be screwed into place, a uniformly small splint can be obtained.

It is now well known that lacerations of the facio-oral soft tissues should not be treated by primary suture. These wounds heal satisfactorily of their own accord, provided that the missing foundation is replaced with fixation material that is kind to the tissues. Reference is made to the textbook of Bruhn.

To the ever-present question of ankylosis of the temporomandibular joint through prolonged immobilization, the answer is that a healthy joint never ankyloses.

Further details of related problems are to be found in the manual of Lindemann.

(Gerlach). John L. Lindquist, M.D.

EYE

Traquair, H. M.: Chronic Dacryocystitis; Its Causation and Treatment. *Arch. Ophth.*, 1941, 26: 165.

It is impossible to estimate with any degree of accuracy the age of onset of chronic dacryocystitis. The average age of onset may be regarded as somewhere near forty years.

Seventeen per cent of the patients observed by the author were males, and 83 per cent were females. The incidence of the congenital condition in infants was equal for the two sexes.

In private practice the patients were of the same social class as the hospital patients.

It seems probable that the number of cases of this condition associated with disease of the neighboring parts, e.g., lupus or trachoma, is greater in some countries or places than in others. In this series of cases, disease in the neighboring parts was rare.

Of all the patients who applied in the first place to the department of rhinology on account of nasal trouble, only 1 was referred from the otolaryngological department to the ophthalmic department on account of dacryocystitis. This would seem to indicate at least that such conditions as deviated septum, swollen turbinates, and the common chronic intranasal sinus, or antral inflammations are not frequently associated with dacryocystitis. Both nasal catarrh and conjunctivitis are more common in children than in adults, and coryza is common in children of all classes, but dacryocystitis is rare in children of school age.

In the incipient stage of the disease there is epiphora, and the nasolacrimal duct is patent and may be irrigated with a syringe with little or no difficulty. This patency may persist, and in many cases it was found that the patient was accustomed to express the contents of the sac downward into the nose. That this can often be done is familiar to all ophthalmic surgeons. Obstruction develops at the lower end of the sac, at the entrance to the lacrimal canal, and is not a primary feature, but may be regarded as a result of the disease.

There are two kinds of dacryocystitis. The first and most common type is characterized by pronounced sex and social predilections and by the absence of any causal factor. Primary dacryocystitis, the second type and the type which has a much lower incidence, is associated with contributory factors, such as local disease or local injury.

Chronic dacryocystitis is often referred to as an "infection" of the sac. There is no evidence pointing to an infectious origin.

In conclusion, the author states that there are two forms of chronic dacryocystitis—primary and secondary. The primary form is common and is characterized by a pronounced sex predilection, occurring in women to the extent of 80 per cent or more. Heredity appears to be the most important factor in its causation. The secondary form is rare and occurs approximately equally in the two sexes, as the result of injury or disease of the neighboring parts. The best treatment is a drainage operation, such as external dacryocystorrhinostomy.

LESLIE L. MCCOY, M.D.

Klien, B. A.: Detachment of the Pars Ciliaris Retinæ; A Contribution to the Diagnosis of Malignant Intra-Ocular Tumors. *Arch. Ophth.*, 1941, 26: 347.

From histological observations in cases of detachment of the ciliary epithelium, including deformity of the lens, which were observed clinically and histologically, a single feature common to all these cases stands out as the primary factor in the pathogenesis of this condition. This feature is postulated to be an increased pressure in the subretinal space either of hemorrhagic origin, as in most of the cases of injuries and in 1 case of perforated corneal ulcers, or of transudative origin, often in combination with hemorrhage, as in the cases of malignant tumors of the posterior segment.

Retinal detachment, in which there is merely a reduction of the intra-ocular pressure, was not accompanied by a detachment of the pars ciliaris retinæ in any of the cases studied. The added factor of increased subretinal pressure is necessary to lead to a peeling off of the ciliary epithelium. On the other hand, increased subretinal pressure alone may lead to it without a preceding reduction of tension, as has been proved by study of the eyes with intra-ocular tumors.

Of the several groups of eyes with retinal detachment which have been studied, there are two, the injured ones and those with perforated corneal ulcers, in which retinal detachment and detachment of the ciliary epithelium, when present, are irrelevant from the standpoint of the differential diagnosis of intra-ocular tumor. In those groups of eyes, the area accessible to intra-ocular examination is frequently limited by opacities of the media and other conditions. When detachments can be seen, their relation to the perforating scars and other conditions is usually sufficient to exclude the question of tumor.

In the remaining groups of eyes with retinal detachment, viz., those of the idiopathic type, those with retinal detachment due to Coats' disease, and those with intra-ocular tumors, for all of which ophthalmoscopy is usually feasible, it is significant that the combination of detachment of the pars optica and of the pars ciliaris retinæ has been found only in the ones with tumors.

While the number of eyes with idiopathic retinal detachment and Coats' disease studied histologically is naturally very small, and ophthalmoscopy of the eyes with clinical idiopathic retinal detachment was done without the contact lens, it would seem that the clinical finding of a detached unpigmented ciliary epithelium points almost with certainty to a condition producing an increased subretinal pressure, and suspicion of a tumor in such an eye should be entertained.

It is a well known fact that even a small tumor may cause an extensive retinal detachment and thus, by its small size or posterior location, may make the results of transillumination doubtful. The additional finding of a detached pars ciliaris retinæ in such eyes should add more certainty to the clinical diagnosis of tumor. Its special value in cases of tumor located too far back to permit decisive observations on transillumination is shown by the fact that its occurrence with tumors was limited, with 2 exceptions, to tumors which were not located anterior to the equator. The peripheral portions of the detached retina in these eyes should be systematically examined by ophthalmoscopy, if possible with the aid of a contact lens, in a careful search for detachment of the unpigmented ciliary epithelium.

It is hoped that this report of a new diagnostic sign will stimulate ophthalmologists to look for it in the ophthalmoscopic examination of all eyes suspected of harboring a malignant tumor, as well as in the histological study of enucleated eyes. Should the investigation of hundreds of cases of intra-ocular tumor demonstrate that the incidence of detachment of the ciliary epithelium is comparable to, or even greater than that in this small series, then its importance as a diagnostic sign of intra-ocular tumor will become firmly established.

LESLIE L. MCCOY, M.D.

EAR

Jones, H. M.: Injuries of the Ear. *J. Laryngol. & Otol.*, 1941, 56: 189.

Ten years ago Jones presented one of a series of papers which he had written on the mechanism of hearing. The principles were novel and interdependent; the movements were difficult to represent diagrammatically, and when represented were conjectural and open to question. Since that time he has prepared models exhibiting the movements and recently published the papers in book form, illustrated with photographs of the models. In this article he recapitulates a few of the salient features, revises the description, and furnishes explanations of the production of the conditions described.

When the membrane is absent all increases in pressure in the tympanum are due to the entrance of air, and if it diffuses uniformly approximately the same pressure is maintained over both fenestræ, and thus immobility results. Inequality of pressure is solely the result of inequality of movement toward the fenestræ, and as hearing is present when the drum is substantially absent, sound waves must move or produce movement, almost exclusively toward one of the fenestræ.

The movements attributed to the various parts of the membrana tympani are demonstrated in detail, and the modus operandi is rendered quite evident by a model of a lawn tennis net. The fibers of the upper and lower halves of the membrana tympani together form a shallow cone; but the fibers of the upper half are, in addition, drawn upward and inward by the manubrium into the shape of a shallow "V". When these fibers are converted into a curve by uniform pressure on their lower and outer surfaces this part of the membrane as a whole moves upward and inward, but the manubrium and contiguous membrane move downward and outward; a movement which is rendered possible by the tangential position of the axis of rotation of the malleus. The consequent outward movement of the stapes is synchronous with an inward movement of the secondary membrane, and the combined movements constitute the reciprocal movements referred to at the beginning of the article.

The fibers of the lower half of the membrane, radiating downward to the lower border of the tympanic ring from the end of the manubrium, can undergo a limited degree of curvature without extension as the manubrium moves downward, because of the approximation of their ends and, consequently, during this period they offer no resistance to movement. It is opposite these fibers that the impulses traveling downward and inward are arrested, and such an arrest gives rise to a definite increase in pressure. Finally, the movements in the external canal terminate at the outer surface of the membrane. Those which cross the tympanum are fresh impulses generated by the deep surface of the membrane and, therefore, travel at right angles to it. The lower and lateral parts of the membrane move to and from the somewhat horseshoe shaped groove in which the fenestra rotunda is situated; the uppermost part to and from the tegmen tympani; and the central part, the movements of which are in the reverse direction, moves from and to the fossa for the fenestra ovalis.

The following experiment gives a realistic conception of the value of a sound wave detectable by the ear. A roundish piece of steel weighing 1 gr. was dropped on to a delicate resonant surface from a distance of 1 in. An individual, who had been placed at a distance of 78 ft. across a lawn with long grass, could hear and detect the nature of the impact. With a fair margin for unknown factors, the sum of the impulses reaching the ear could not have represented 1/100,000,000th part of the impact of the metal, assuming that it had been completely converted into sound; and it is on the detection of impulses of this magnitude that existence depends.

The functions of the different parts of the membrane, though complementary, are different, and the effects of their destruction vary. With material destruction both the reciprocal and antagonistic, or protective, movements are partially or completely lost, and, consequently, the reception of the more delicate, and the correction of the more violent impulses are defective or absent. This affords an explanation of the apparently paradoxical symptom in which noises, which formerly were not unpleasant, cause distress, after material destruction has occurred of the membrane of one or both ears, and those noises which had formerly caused distress are now intolerable.

Nature by a process of evolution has produced in the ear one of those protective mechanisms which gradually develop under conditions which are prevalent for a prolonged period, but protection against the catastrophic conditions introduced by modern science is excluded. The protective mechanism not only safeguards the labyrinth under normal conditions; it also probably preserves the exquisite sensitivity of the ear as well as enables it to detect faint sounds when other noises are present; but the protective counteraction does not increase with uniformity. It develops with increasing rapidity as the margin of safety is approached, and under abnormal conditions, such as blast, would become so excessive that the pressure over the fenestra ovalis would become a greater danger than that over the fenestra rotunda, against which, under normal conditions, it acts as a safeguard.

Anything which restricts the movements of the stapes, either directly or indirectly through loss of mobility of the membrana tympani, increases bone conduction. On the other hand, a perforation which reduces the area of the membrane and maintains equality of pressure on its opposite sides during movement removes one source of resistance to movement of the stapes, increases the movement of fluid toward the fenestra ovalis and reduces that toward the fenestra rotunda, and produces a corresponding reduction in bone conduction.

Fixation of the stapes increases bone conduction. Fixation plus an inward movement of the ossicles decreases it. The phenomenon is not due to increased pressure in the tympanum, because that can be increased to a greater extent, if not associated with an inward movement of the stapes, without effect. It is not due to inequality of pressure on the two sides of the basilar membrane because the helicotrema renders that impossible. It is not due to fixation of the stapes; so that by a process of elimination only the secondary membrane remains, and this furnishes an explanation. This membrane is forced outward, subject to tension, and its movements are restricted. NOAH D. FABRICANT, M.D.

Whitby, L. E. H., Brewer, H. F., James, J. A., Jory, N., and Others: Discussion on Chemotherapy, Serotherapy, and Hemotherapy in Otology and Laryngology. *Proc. Roy. Soc. Med.*, Lond., 1941, 34: 665.

WHITBY states that in dealing more especially with chemotherapy he must first emphasize that the principles for the use of sulfonamide drugs are the same for the ear and larynx as in any other part of the body. First, it is essential for the infecting organism to be sensitive to the drug employed.

The second principle is that the drug must reach an effective level and be maintained there until a full clinical result is obtained.

The third principle is certainty that the drug acts in a favorable medium and position.

BREWER is of the opinion that the new chemotherapeutic agents have an action which is entirely anti-bacterial and that they do not affect toxins other than by influencing the organisms producing them. Appropriate antitoxin sera are still of value, if only as adjuvants to chemotherapy; also, the supplementing of chemotherapy with a suitable antibacterial serum may enhance the effect.

JAMES states that since the introduction of the sulfonamide group of drugs there have been by comparison relatively few advances in serotherapy and hemotherapy. Previously chemotherapy was rarely used in laryngological and otological practice. Serotherapy provided the only specific treatment of proved efficiency, with hemotherapy as an adjuvant method. Chemotherapy with the sulfonamide group has now almost supplanted the other two methods in the treatment of suitable infections.

JORY states that not many years ago the tendency in England was to operate early upon the mastoid, some even opening the drum and the mastoid at the same time, largely because they were unwilling to have meningitis or any other uncontrollable complication develop while they, but not the patient's defence mechanism, remained inactive. Now the tendency is to operate later and later, and one is agreeably surprised at the number of cases which resolve eventually in spite of early alarming symptoms. This moral support by sulfonamides seems to Jory an unpublicized but very real benefit.

LAYTON said that inflammations of the middle-ear cleft must be studied bacteriologically. The terms "acute" and "chronic" should be abandoned for "pharyngeal" and "cutaneous" inflammations of the middle-ear cleft. The tube of broth into which a piece of infected material is dropped is therefore as essential a part of the mastoid operation as is the gouge with which it was removed.

WATKYN-THOMAS said that in assessing the results up to date of the sulfonamide treatment account must be taken of the moral support that it gave by encouraging people to wait a little before operation on the mastoid.

CAWTHORNE said that it was in the treatment of meningitis that the most dramatic results of chemotherapy had been seen. JAMES C. BRASWELL, M.D.

Lillie, H. I., and Simonton, K. M.: Abscess of the Mandibular Fossa Secondary to Otitis Media. *Arch. Otolaryngol.*, 1941, 34: 485.

Abscesses of the mandibular fossa have been observed only twice at the Mayo Clinic. These abscesses were not situated in the true mandibular fossa, as they were not within the articular capsule from the surface of the bone.

Abscess of the mandibular fossa must be distinguished from abscess of the temporal fossa (zygomatic). In both the manifestation of extension, so far as swelling of tissues is concerned, is similar. The pain of the so-called zygomatic abscess is not so severe as the pain of abscess of the mandibular fossa. Trismus in cases of abscess of the zygomatic fossa is a minor complaint compared to trismus associated with abscess of the mandibular fossa. Roentgenological examination usually will give evidence of the presence of mastoid cells beyond the anterior root of the zygoma in cases of abscess of the zygomatic fossa, but this does not necessarily occur in abscess of the mandibular fossa. Inspection of the roentgenogram for the gasserian fissure may be helpful. If the fissure can be seen definitely, it may be inferred that it is patent. It would be possible for infection to extend to both the mandibular and temporal fossa in cases in which a certain anatomical arrangement of the structures is present.

The treatment of choice of abscess of the mandibular fossa secondary to otitis media seems to be direct, primary, surgical exposure of the mandibular fossa because it is believed that the abscess originates in the mandibular fossa and spreads to the pterygomaxillary fossa. It is obvious that a direct approach at the origin of the abscess is preferable to external drainage of a secondary extension. Manifestly it is also advisable to drain the abscess before resorption of the bone over the dura takes place. From experience in these 2 cases it was learned that the approach to the mandibular fossa can be purposeful and direct. The incision employed for a mastoid operation is extended above and around the upper attachment of the ear. Cutting into the temporal muscle is avoided after exposure of the temporal muscle by making an incision to the bone along the lower aspect of the zygoma to a point just beyond the articular eminence of the mandibular fossa. The temporal muscle and fascia are freed upward sufficiently, and the structures below are separated downward to expose the anterior wall of the bony canal and the curve of the middle root of the zygoma which forms the fossa on the inner aspect. With a sharp chisel or gouge a wedge of bone is removed in the direction of the middle ear to the site of the opening of the eustachian tube into the middle ear. The articular capsule is then separated from the mandibular fossa with a suitable periosteal elevator. The field is held open by retractors and the abscess is thus exposed and dealt with surgically as the conditions found seem to indicate. Suitable drains are inserted and the upper part of the wound is dressed and kept open until healing takes place.

If the abscess has extended to the pterygomaxillary fossa, the question of secondary through and through drainage will need to be settled at the time. If secondary drainage is deemed necessary, an incision involving the parotid gland must be avoided because of the danger of persistent parotid fistula. Secondary drainage may need to be made and depends on the extent of the involvement. The exact position of such secondary drainage would depend on the actual conditions encountered.

NOSE AND SINUSES

Scher, S. L.: The Deformed Nose. *Arch. Otolaryngol.*, 1941, 34: 307.

Scher defines corrective rhinoplastic surgery as a specialty which deals with the correction of nasal defects, congenital or acquired, with the aim of improving both function and esthetic effect. Keeping in mind the importance of function, since health is of primary importance and beauty secondary, the rhinoplastic surgeon must strive toward both in each operative procedure. The object of this article is to describe typical cases encountered in the practice of rhinoplastic surgery, and the nasal deformities amenable to treatment, and to demonstrate what may be expected in the correction of disfigurements about the nose by partial or complete endonasal rhinoplasty.

Listed among common nasal deformities are (1) deflected nose, (2) hump nose, (3) elongated nose, (4) bulbous nasal tip, (5) saddle nose, and (6) combined deformity of the nose and chin. These may occur separately or in combinations. For example, the nose may be elongated and twisted, with a bulbous tip, or a hump nose may have no other deformity. The correction of each deformity is the same, whether it occurs singly or in combination. The author describes an original method for the correction of a bulbous tip.

Complications in rhinoplastic procedure occur infrequently and demand judicious treatment. The novel complication of "intranasal keloid" is reported for the first time. This condition occurs approximately from two to four weeks after nasal repair and is seen along the site of the preliminary intranasal incisions used for approach to the nasal bridge. It is characterized by induration, thickening, and reddish discoloration along the site of the incisions. This gives the appearance of bilateral overdevelopment of the lateral cartilages (potato nose). Of 4 patients with this complication, 3 responded to mild roentgen therapy over a period of from four to six weeks, and the nose gradually became normal. The fourth patient exhibited marked proliferation and remained resistant to roentgen irradiation after six months of treatment. In cases in which there is a history of keloid, early roentgen therapy immediately following the operation seems the minimum requirement in prophylaxis.

NOAH D. FABRICANT, M.D.

Wilkerson, W. W., Jr.: Mucocele of the Frontal Sinus; Report of a Case. *Arch. Otolaryngol.*, 1941, 34: 321.

Wilkerson observes that on examination of a mucocele of the frontal sinus, no inflammatory changes are noted over the swelling, and no tenderness occurs unless a secondary infection has taken place. Crepitus may be present when the bone becomes thin and cracks. After absorption of bone has taken place, the edges of the bone may be felt. The eyeball may be displaced outward, downward, and forward. Yet the changes are wrought so slowly that the occurrence of diplopia is comparatively infrequent. The mass may feel soft and elastic on palpation or may be found to fluctuate. The appearance of the nares is not usually suggestive, yet at times a bulging in the region of the anterior third of the middle turbinate is indicative.

A mucocele of the frontal sinus may erode the inner plate, destroy the dura, pia, and arachnoid, and for a time produce no symptoms. Recovery after a correct surgical procedure is the rule. In the case reported, a dural graft might have been inserted at the time of the operation had the author been prepared for the condition which was found. The orthodox closure in a case such as that reported here is the removal of the anterior plate of the frontal sinus, with collapse of the soft parts against the inner wall. Despite this fact, there was less danger of an intracranial infection with the procedure employed in this case. In a case such as this the ethmoid labyrinth should not be disturbed more than is necessary. The nasopharyngoscope was of definite value in examining the interior of the sinus before the secondary closure. The Lynch radical frontal operation practically never causes any cosmetic deformity. Here, despite the surgical modification employed, there was no exception. A roentgen examination made eight years after the first operation revealed no abnormalities other than a slight haziness of the frontal and ethmoid sinuses.

NOAH D. FABRICANT, M.D.

MOUTH

Niño, F. L.: Myiasis from the Larvæ of "Cochliomyia Hominivorax"—Coquerel, 1858—Complicating a Cancer of the Lip (Miasis por larvas de "cochliomyia hominivorax"—Coquerel 1858—complicando un cáncer de labio). *Bol. inst. de clin. quir.*, Univ. de Buenos Aires, 1941, 17: 510.

A case of myiasis is described in a farmer forty-nine years of age who had been treated for cancer of the lip. During the treatment he felt an intense pain in the mouth which was relieved only by the discharge through the lower lip of 24 vermiform larvæ which proved to be those of cochliomyia hominivorax (Coquerel, 1858).

A detailed description with photographs is given of the larva, pupa, and fully developed adult of this fly which has been described under various names. Larvæ of this species have caused the great majority of cases of myiasis of the body cavities, such as the nose and ear, also genital myiasis and myiasis developing on skin wounds or ulcers, and at least 1 case of intestinal myiasis and 2 cases of myiasis in furunculosis. AUDREY G. MORGAN, M.D.

Cromartie, W. J., and Nelson, O. G.: Adenocarcinoma of the Tongue Arising from a Vestige of Median Anlage of Thyroid Gland; Report of a Case. *Arch. Surg.*, 1941, 43: 599.

The median anlage of the thyroid gland originates as a diverticulum from the mesobranchial region of

the pharyngeal floor which lies between the ventral extremities of the first two gill pouches. Maldevelopment of the median anlage is known to give rise to a variety of abnormalities which may be located in the midline from the foramen cecum to the level of the suprasternal notch. These include solid tumors, cysts, sinuses, and fistulas. A solid tumor of the thyroglossal tract is most common in the region of the foramen cecum, although microscopic amounts of thyroid tissue may occur in any part of the primitive tract. Such a tumor usually consists of well differentiated thyroid tissue and constitutes a lingual thyroid. In the majority of the recorded cases of this condition in which histological study was made, the structure of this aberrant tissue was similar to that of the normal gland. In a small percentage the fetal pattern of thyroid tissue was found. Cystic changes were not uncommon, being especially prominent in large lingual glands in cretins.

Malignant tumors of the tongue, the histogenesis of which seems to represent an abnormal development of the anlage of the thyroid gland, have also been reported. The authors review these cases and also report one of their own. In this case the vestige maintained its embryonic structure, invaded the musculature of the tongue, and metastasized to the lungs. SAMUEL H. KLEIN, M.D.

PHARYNX

Figi, F. A.: Cancer of the Pharynx and Larynx. *Surg. Clin. North Am.*, 1941, 21: 1027.

From a therapeutic standpoint malignant tumors of the pharynx may be divided into three distinct groups: (1) those of the nasopharynx, (2) those of the tonsil and oropharynx or pharynx proper, and (3) those of the hypopharynx and base of the tongue.

Irradiation is the treatment of choice in malignant lesions of the nasopharynx. Until the past year or two the most satisfactory response in these cases has been secured by applying intensive irradiation in the form of radium packs externally about the head and neck and placing radium tubes on a pliable applicator directly in contact with the growth in the nasopharynx. During the past year the author has treated a group of these patients with fractional dosage roentgen therapy according to the method of Coutard. As yet insufficient time has elapsed to permit of determining the ultimate results with this treatment but the primary response has been very favorable.

The more active epitheliomas of the tonsils and oropharynx should be electrocoagulated and radium points immediately inserted into the coagulated region. The lymph nodes are removed surgically and this procedure is supplemented by surface irradiation. In some of the more active lesions, radon seeds are implanted in the metastatic nodes directly through the intact skin or following surgical exposure of such nodes. The mixed tumors are best excised either through the mouth or by an external incision. Treatment of the lymph nodes is not necessary.

Irradiation is the treatment of choice in the majority of cases of malignant tumors of the base of the tongue and hypopharynx.

Thyrotomy and laryngectomy are the procedures most commonly employed in the removal of malignant tumors of the larynx. Pharyngotomy, endoscopic methods, and irradiation are useful in selected cases. In recent years the scope of thyrotomy has increased and the operation is being performed in an increasing proportion of cases.

When the malignant process in the larynx is too extensive to permit of its removal by laryngofissure, laryngectomy alone offers a reasonable chance of controlling the disease.

Radiologists and laryngologists generally agree that carcinoma which is limited to the interior of the larynx should be dealt with surgically and that the surgical treatment should be supplemented with irradiation, if deemed advisable.

NECK

Caulk, R. M.: Tomography of the Larynx. *Am. J. Roentgenol.*, 1941, 46: 1.

Satisfactory tomographic studies of the larynx can be made with simple, inexpensive apparatus giving information that in the past has been impossible to obtain. The value of tomography of the larynx is cited by study of the normal larynx and by the report of 2 cases of laryngocele. Tomographic investigation of laryngeal tumors, when correlated with the history, physical examination, and routine roentgen studies, gives further insight into their site of origin and extent of growth. Tomographic study of the larynx is of more value in lesions producing deformity in the coronal plane than in the sagittal plane. The larynx occupies the unique position of being one of the few organs in the body which can be studied readily in all three planes, i.e. horizontal, sagittal, and coronal. Thus, a new source of information is available to the oncologist, the roentgenologist, and the laryngologist. NOAH D. FABRICANT, M.D.

Work, W. P.: Paralysis and Paresis of the Vocal Cords; A Statistical Review. *Arch. Otolaryngol.*, 1941, 34: 267.

Dysfunction of the vocal cords is ascribed to several recognized causes, such as lesions of either the central or the peripheral nerves, or local changes, such as neoplasm or ankylosis of the various joints, particularly of the cricoarytenoid joint. The dysfunction may be partial (paresis) or complete (paralysis) and, whether present in one or both cords, may or may not be manifested clinically. It is known that, particularly if a non-functioning vocal cord lies in the cadaveric position, the opposite cord will often cross the midline, so that no symptoms either in phonation or in respiration result. If one vocal cord lies in the midline, the compensatory function of the other cord is assured. Both cords lying in the cadaveric position permit the patient to carry on respiration with little embarrassment, but phonation

is poor; however, the reverse is true if both cords lie paralyzed in the midline.

Work finds that paralysis of the recurrent nerve occurs later in life in males than in females, if paralysis associated with operation on the thyroid gland is disregarded. Thirty per cent of the patients with paralysis of the vocal cord have no laryngeal symptoms. Fifty per cent have no symptoms with paretic involvement of the vocal cords. Transient paretic conditions of the vocal cords associated with central cerebral lesions exist; they may be unilateral or bilateral and are probably missed clinically for the most part. Postoperative paralysis of the recurrent laryngeal nerves associated with thyroidectomy occurs in females and in males in a ratio of approximately 7.4 to 1. The left nerve is slightly more often involved. The median and cadaveric positions of the cords occur with equal frequency. Bilateral impairment of the vocal cords occurs about once in every 6 cases of postoperative paralysis associated with thyroidectomy, and in this group the median position of the vocal cords is most often encountered. Paralysis of the laryngeal nerve may occur after one-stage total pneumonectomy.

If one disregards cases in which postoperative paralysis is associated with thyroidectomy, the left vocal cord is more often affected by paralysis than the right. The median position of the cords is more often encountered than the cadaveric. Prognosis for recovery of the vocal cords is approximately 25 per cent in cases of postoperative paralysis associated with thyroidectomy, and 50 per cent in cases of paresis. Recovery, if it takes place, usually occurs within six months. Prognosis for recovery from paralysis other than the postoperative type has been found to be poor (5 per cent); in the paretic group the prognosis has been found to be better.

NOAH D. FABRICANT, M.D.

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Sanchez-Perez, J. M.: Cerebral Angiography. *Surgery*, 1941, 10: 535.

The author of this article, a pupil and staunch admirer of Egas Moniz of Lisbon, is seriously imbued with the value of cerebral angiography in the diagnosis of intracranial lesions. A short and interesting account of the development by Moniz of this diagnostic procedure is given in the article, and several good figures illustrate the results which may thus be obtained in the visualization of the cerebral vascular tree. It is pointed out that cerebral angiography demonstrates how faulty most textbook descriptions are concerning the intracerebral vascular patterns. For the person interested in personally performing cerebral angiography concise directions are given, together with a description of the three phases of cerebral circulation. According to the author's figures, the circulation time from the external carotid artery to the external jugular vein is from five to six seconds. The procedure may be of value not only in the localization of such tumors as the gliomas, but more especially in those tumors of vascular type (which are often diagnosed clinically with difficulty), such as angiomas and aneurysms. Intracranial hemorrhage and cerebral arteriosclerosis may also be demonstrated.

The author uses and advocates thorotrast as the contrast medium. He states that its "absolute harmlessness to the patient" and its ease of application deserve its wider use and favorable consideration in America. In connection with this article the reader should not fail to see another current article (Gross, S. W. *Arch. Neurol. and Psychiat.*, 1941, 46: 704), which also justifies the right of cerebral angiography in neurological diagnosis, but which distinctly decries the use of thorotrast as a dangerous, harmful drug. JOHN MARTIN, M.D.

Adams, R. D., Schatzki, R., and Scoville, W. B.: The Arnold-Chiari Malformation. *New England J. Med.*, 1941, 225: 125.

The case reports of 2 patients with cerebellar malformation found at operation are presented in detail. One of the patients had an associated meningomyelocele, while the other did not. Both patients survived suboccipital and high cervical decompression, and were followed up for six and eighteen months, respectively. Improvement was observed in both cases but the neurological signs were essentially stationary.

The symptoms resulting from this malformation may be divided into five groups:

1. Those due to increased intracranial pressure. The headache is usually occipital, suboccipital, and cervical in location, comes on suddenly, and is of several hours' duration. It is most apt to occur during the night or early morning, and resembles in most respects the cerebellar-tumor headache. Usually the papilledema is not as marked as that in cerebellar tumor.

2. Involvement of several of the cranial nerves. Any one or several of the cranial nerves may show signs of injury, especially the lower ones. Because of the displacement of the medulla into the spinal canal, the lower cranial nerves must pass upward through the foramen magnum to enter the cranial vault. Thus they are stretched and often pinched as they pass through the foramen.

3. Compression of the brain stem. Nausea and vomiting are attributed to medullary compression, as with cerebellar tumors. Other signs such as disturbances of conjugate deviation and vertical nystagmus are thought to be caused by intramedullary or intrapontine lesions.

4. Compression of the spinal cord. Both patients had bilateral pyramidal-tract signs. Others have had sensory disturbances.

5. Cerebellar signs. These may be the most striking part of the neurological picture, or they may consist of only slight gait disturbance, intention tremor, or inco-ordination of movement.

Several conditions enter into the differential diagnosis. On the basis of whether the cerebellar symptoms, the cord symptoms, or the intracranial pressure symptoms are most marked, one considers the presence of cerebellar tumor, syringomyelia and syringobulbia, high cervical cord tumor, intrapontine or intramedullary tumor, chronic adhesive arachnoiditis, cerebellar degeneration, or platybasia. When the patient exhibits signs of a lesion involving several cranial nerves, the cerebellum, and the brain stem, and of increased intracranial pressure, together with significant cerebrospinal-fluid findings, most of these conditions are excluded. Lumbar puncture and myelography were found to be of diagnostic aid. The former showed a complete block in the dynamics of the cerebrospinal fluid. The myelographic appearance of the protruding cerebellar "tonsils" seems to be characteristic of the malformation. There is a block of lipiodol injected below the lesion and a small central incisura outlining the bifid projection of the two herniated cerebellar hemispheres. JOHN L. LINDQUIST, M.D.

Robb-Smith, A. H. T., Hunt, A. H., Russell, D., Greenfield, J. G., and Others: Discussion on Fat Embolism and the Brain. *Proc. Roy. Soc. Med.*, Lond., 1941, 34: 639.

ROBB-SMITH says that the role of trauma in fat embolism cannot be overlooked and is obviously of prime importance, but the exact manner in which the fat reaches the venous circulation has never definitely been proved. The classical picture of pul-

monary fat embolism is to be seen in an accidental injury, usually with a fracture, and often when there has been a delay in immobilization. At first the picture is one of shock, which improves somewhat, only to have the patient lapse into a state resembling acute pulmonary edema. The outlook for recovery is generally poor. Lumbar puncture shows no increase in the intracranial pressure and no constant cytological or chemical change in the fluid, although fat has been noted in the fluid. Retinal edema and hemorrhages are occasionally found.

HUNT states that fat embolism, though not a common condition, is a very serious complication for the patient. The clinical manifestation of cere bral or systemic fat embolism is most characteristic, in contrast to that of the pulmonary type. The mul tiplicity and changeability of the cerebral symptoms (especially when complicated by actual cerebral trauma), cutaneous petechiæ, pulmonary edema or frank pneumonia, changes in the temperature, pulse and respirations, and fat in the urine—all these sum up to a fairly constant clinical syndrome.

RUSSELL reported the necropsy findings on the brains of 2 patients dying of cerebral fat embolism. Petechial hemorrhages were numerous in engorged areas of the cortex, where the capillaries and precapillary arterioles were found to be occluded by round or oblong masses of fat. Also, large numbers of capillaries were blocked by fibrin thrombi, while others were blocked by accumulations of neutrophile leucocytes. In places, the fat emboli and fibrin thrombi were associated with areas of anemic necrosis with various changes in the cell bodies and processes of the ganglion cells. Such necrosis was less marked in the white matter of the brains. The degree of vascular disturbance was greater in the chorioidal plexuses than in any other part of the brain. Widespread blocking of the capillaries and arterioles had occurred, and the epithelium of the plexuses had undergone a severe albuminous degeneration.

GREENFIELD added that the hemorrhagic lesions in the brains with fat embolism may be relatively insignificant in themselves. He believes that the ischemic degeneration of neurones and myelin is of much more importance in the production of the symptoms of the complication.

FRAZER pointed out that the intake of food containing fat, some of which most certainly passes into the blood stream during digestion, might have something to do with the production of fat embolism in patients suffering trauma after a fatty meal. After digestion, fat in certain organs, especially the liver, is definitely affected by anesthesia.

MEYER investigated the brain of a psychotic per son in whom cerebral fat embolism was caused during treatment with "triazol," and he was of the opinion that the widespread cerebral arterial thromboses might have been directly caused by severe disturbances of the blood circulation after fat embolism.

STEWART believes that fat emboli arise from the damaged tissues themselves, rather than from already circulating blood fat.

WRIGHT recalled that a Japanese author had written an article describing a technique which had been evolved for the estimation of the size of fat globules in the blood plasma. If, after a fracture, he found globules of such a size as were likely to produce fat embolism, he became alert to the development of the symptoms of this condition in the patient, and could take early measures to combat it.

DENNY-BROWN states that myelin degeneration in cerebral fat embolism may be slow to develop, and the traumatic unconscious and confused states may possibly be due only to an early cerebral fat embolism, before myelin changes have occurred.

GARDNER says that fat embolism is especially frequent after automobile accidents, and commonly the patients have sustained large fractures. This is an especially dangerous condition in old people. Extreme gentleness in the manipulation of fractures must always be the rule.

On the basis of these reports and other literature as well, JEFFERSON believes that bone injury is a significant source of fat embolism. Operation on the fatty breast, omentum, abdominal wall, and other fat-laden tissues do not cause those fatalities of fat embolism which are sometimes to be seen following fractures. In soft-tissue surgery, however, veins are ligated, but this is impossible in the osseous venous sinuses. Also, the type of fat in the bone marrow is not the same as that of the soft tissues, and the marrow fat may, under conditions of trauma, have a special predilection for the veins of the bony medulla.

JOHN MARTIN, M.D.

Da Costa, D. G., and Adson, A. W.: Subdural Hydroma. *Arch. Surg.*, 1941, 43: 559.

Single or multiple trephine openings for the evacuation of encysted fluid between the dura and the arachnoid are indicated when a patient has sustained a head injury from which he does not recover promptly. This is true especially when the pneumoencephalographic study suggests a flattening of one or both cerebral hemispheres with little or no air in the subarachnoid spaces in the temporoparietal region. Persistent headache following an injury frequently is the result of a subdural hematoma or a subdural hydroma and justifies exploratory trepanations over the site of involvement.

Occasionally it is possible to drain this collection of fluid through a single trephine opening; however, if a large collection of fluid with marked depression of the brain is present, it is wiser to make two trephine openings over the affected hemisphere, one placed near the midline over the premotor portion of the brain and the other in the temporal region. Through-and-through drainage is achieved by the introduction of a No. 19 French catheter. This is left in place from three to five days or until the lateral ventricles have expanded to their normal size and the space between the dura and the arachnoid has become obliterated.

Although a hydroma is more often unilateral than bilateral, it usually is wise to place a trephine open-

ing on the opposite side in a position similar to the one made over the frontal lobe in order to make sure not to overlook a bilateral lesion. Occasionally a hydroma has a tendency to reform. If this situation should develop, redrainage or longer continuous drainage through the temporal trephine opening will be necessary. Other procedures such as the employment of an osteoplastic flap and repeated drainage by aspiration have been employed.

The operative results depend on the duration and the severity of the symptoms. Patients who have had symptoms of short duration without destructive cerebral changes make complete recoveries.

Busch, E.: The Astrocytomas of the Corpus Callosum. *Acta chirurg. Scand.*, 1941, 85: 76.

In a series of 759 verified intracranial tumors, the corpus callosum was found to be involved in 39 patients. In only 8 of these was the tumor definitely primary within the corpus callosum, and all 8 were astrocytomas. Contrary to most other reports to be found in recent literature, Busch is optimistic in his outlook upon the results of the surgical treatment of these tumors, and he thinks that the pessimism of others is due to the fact that their tumors were bilateral glioblastomas, bridging from one to the other hemisphere across the corpus callosum.

Four patients had epileptiform seizures with loss of consciousness, 2 had unilateral convulsions, and 2 showed no motor phenomena at all. In 2 patients the convulsions started in both legs. Loss of sphincteric control was present in 4 patients, and present in 7 patients to a marked degree for several weeks after operation, when the mental condition of the patient could not have been the cause of such loss of control. Sphincteric control was ultimately regained in all patients. Signs of increased intracranial pressure were present in all patients, headache and papilledema being the most constant of these symptoms. The mental disturbances of these 8 patients were not different in quality or degree from the psychic changes usually noted in other types of supratentorial tumors. The "syndrome of the corpus callosum" and Alpers' "imperviousness to outer stimuli" were not found in those patients, and the author believes that these states are due, rather, to bilateral cerebral glioblastomas, in which instances the tumor arises in one hemisphere and spreads to the other by invasion through the corpus callosum. Ventriculography was of much aid in the diagnosis and localization of the lesions. The operative approach is through a right frontal osteoplastic craniotomy, with section of the falx. Resection of a part of the medial portion of the right frontal lobe may be necessary, as well as occasional ligation of the right anterior cerebral artery. JOHN MARTIN, M.D.

Hutton, E. L., Fleming, G. W. T. H., and Fox, F. E.: Early Results of Prefrontal Leucotomy; Review of the Literature. *Lancet*, 1941, 241: 3.

Prefrontal leucotomy has been widely adopted since its introduction by Moniz in 1936. Among other exponents are Rizzatti (Racconigi); Bagdasar and Constantinesco (Bucarest); Pimenta (São Paulo); Sai (Trieste); Lyerly (Florida); Watts and Freeman (Washington, D. C.); Ventura (Pisa); Ody (Varese); Ferdiere (France); and Mixter, Tillotson, and Wies (America). The total number of recorded cases was estimated by Rizzatti and Borgarello in 1940 as at least 500. Hutton has compiled a list of 330 of these. Only 5 deaths of this total are recorded as being due to the operation.

The procedure first developed by Moniz consisted in the injection of alcohol into the subcortical white matter; in later cases a leucotome with a steel loop was used, which crushed the white matter in the subcortical area; finally Moniz adopted a leucotome with a steel band which cut rather than compressed. Lyerly and Freeman have modified the technique.

Moniz treated cases of functional and organic psychosis. Rizzatti and Borgarello treated schizophreniacs, paranoiacs, melancholiacs, and a few cases of disorders of conduct. Lyerly restricted his cases mainly to depressions. Freeman chose cases of involutional or agitated depression, psychasthenia, or schizophrenia in which worry was the predominant factor.

Moniz described a number of mild and transitory symptoms which lasted from several days to several weeks postoperatively. In every case there was a slight rise in temperature, and headache. There was occasional vomiting, and somnolence lasting a day or two was usual. The neurological signs noted were trismus and fibrillary contractions of the masseter and platysma muscles, sphincter disturbances, and ocular disturbances. Mentally there was apathy and loss of initiative, akinesia, resistiveness, mutism, negativism, loss of facial expression, and disorientation. Catatonic attitudes, kleptomania, and a sensation of hunger were noted in a few cases. With the adoption of the cutting leucotome, Moniz claims that these symptoms were rarely observed except for the ocular signs. Rizzatti and Borgarello describe transitory aphasia and hemiplegia in 7 per cent, vomiting and convulsions in 40 per cent, and fever in 49 per cent. Lyerly observed no serious complications. Freeman mentions headache, loss of facial expression, absence of spontaneous activity, and disorientation.

Prefrontal leucotomy seems to be rarely followed by undesirable sequelæ. Freeman reports transitory disturbances: emotional flattening, procrastination, diminished spontaneity and laziness, poor judgment, talkativeness, facetiousness, euphoria, restlessness, aggressiveness, perseveration, indecency, plateau speech, masked facies, convulsions, sphincter difficulties, and monoparesis.

Psychological tests have been used by Lyerly and Worchel, and Freeman. The only significant change found by Lyerly and Worchel was the failure of the patients to do the free association test of the Stanford-Binet examination. Hunt who examined Freeman's patients found less distractibility and more satisfactory co-operation after leucotomy, although

the initiative in starting the tests was less. Patients were less concerned over incorrect performances and were slower in carrying out tests. There was no sign of decrease in total intelligence, and accuracy on the average was improved.

The authors report a series of 8 cases. Two schizophreniacs and 1 depressive showed great improvement. One depressive showed mild improvement. Three schizophreniacs showed very little improvement, and 1 patient died from myocardial fibrositis and atheromatous coronary arteries.

The electro-encephalogram showed that immediately after the operation there was always a very large, very slow discharge, reminiscent of that following head injury. It was not restricted to the areas about the incisions or the frontal lobes, and often involved the whole cortex, particularly while the patient was somnolent and unresponsive. It was not well synchronized in the two hemispheres. In the weeks following the operation the size of these slow potentials diminished progressively and the source became limited to the frontal regions, sometimes more on one side, and sometimes more on the other.

DAVID J. IMPASTATO, M.D.

Collier, D. J., Young, J. Z., Cooksey, F. S., Cawthorne, T., and Wright, A. D.: A Discussion on the Limitations of Operative Treatment in Traumatic Facial Paralysis. *Proc. Roy. Soc. Med.*, Lond., 1941, 34: 575.

Suture of the facial nerve beyond the point of its emergence from the stylomastoid foramen is sometimes possible, but more than likely it is not possible, or, if the ends can be approximated, scar tissue resulting from the sutures or inaccurate approximation will defeat the regeneration of the nerve. Trauma to the facial nerve any place in its course within the petrous bone, middle ear, or mastoid bone does not, of course, allow repair by suture. For this reason the use of prepared plasma gel to hold in accurate apposition the ends of a graft is looked upon hopefully by these authors since they believe that the greatest obstacle in the regeneration of the facial nerve is the formation of fibrous tissue at the severed end of the nerve. Pre-degenerated grafts, usually taken from the medial femoral cutaneous nerve, are used with greatest success, and indeed such grafts have been found to allow regeneration just as rapidly as do fresh transplants. They have the added advantage of being more easily handled, and of allowing a clean, squarely cut end to be applied accurately and without suture (using plasma) against the end of the facial nerve. Especially when the location of the lesion is within the fallopian canal can such grafts be accurately placed, with justified confidence in functional return of the nerve.

During the period of recovery two objects must be kept in mind: promotion of regeneration of the facial nerve, and preservation of the facial muscles in the best condition possible. When the nerve is known to have been damaged, the electrical changes of reaction of degeneration do not appear before ten days after the injury, and they are not reliable before the fourteenth day. At clinical examination failure of the nerve to respond to the full strength of the faradic current, together with the sluggish galvanic response in the muscle, may be taken as strong evidence that the reaction of degeneration is complete. This being the case, two periods in the phase of treatment and recovery must be recognized.

In the first stage, there is a period of complete paralysis which lasts until the regenerating axon reaches the motor end plate, and during this period treatment is directed toward maintaining the condition of the muscles in as favorable a state as possible for ultimate recovery. Splints, massage, and galvanism are the agents to be employed. During the second stage, the stage of recovery, there is first seen a flicker of returning power on stimulation of the muscles, but the physical therapist must not be overzealous in the use of galvanic stimulation, for it can cause more harm than good. Ten gentle contractions of the muscle daily are sufficient.

Re-education is of prime importance in this second stage, whereas stimulation and massage are of secondary value. With the normal side of the face relaxed, the patient must repeatedly stand before the mirror and practice re-educational movements with the returning muscles on the weak side. Recovery may take as long as three years, and even then it is not uncommon to find that parts of the facial musculature, as the frontalis muscle, have not completely regained their full power of contraction. Mass movements and grimacing on the affected side may be a major limitation to success, regeneration of the nerve having been attained, and this may in part be accounted for by the fact that only a part of the active nerve fibers find their way down into the degenerated nerve. Faciohypoglossal anastomosis may be done after a 100 per cent grafting failure, and, the anastomosis failing, the operation of Gillies (1934) may be resorted to.

JOHN MARTIN, M.D.

SPINAL CORD AND ITS COVERINGS

Van Buskirk, C.: Nerves in the Vertebral Canal; Their Relation to the Sympathetic Innervation of the Upper Extremities. *Arch. Surg.*, 1941, 43: 427.

Using cats as his experimental subjects, this author concludes that most of the fibers of the recurrent branches of the communicating rami terminate in relation to the blood vessels and other supportive tissues within the vertebral canal. Some, however, penetrate the bone of the vertebræ, while some join ventral spinal-nerve roots at higher levels than the foramen through which they enter the vertebral canal. Such unmyelinated fibers, passing upward to emerge at a higher level with spinal roots, may ascend (at least in the thoracic regions) as much as six or more segments. Such a plan of ascending intraspinal fibers corresponds with the finding of White that "complete sympathetic denervation of the up-

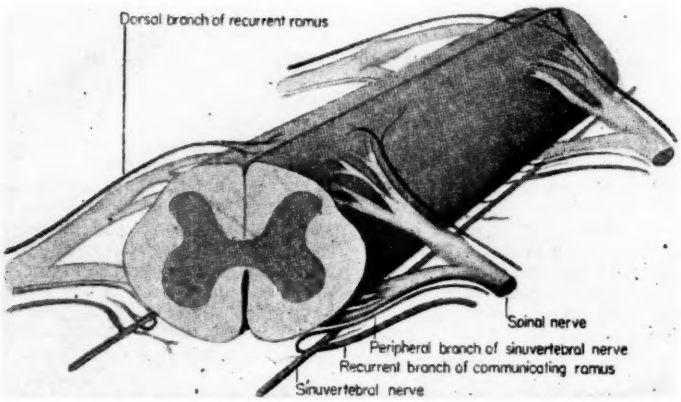

Fig. 1. Nerves in the vertebral canal.

per extremity in the monkey, by section of the anterior roots of the thoracic nerves, requires section of all the roots down as far as the 12th thoracic segment." Thus an explanation is afforded for the failure to obtain complete sympathetic denervation of the arm by extirpation of the stellate ganglion and the upper two or three thoracic segments of the sympathetic trunk.

Kirgis reported in 1941 that in many human cadavers one may find that the third thoracic nerve gives rise to a slender ramus which joins the second thoracic nerve near the junction of the latter with its communicating ramus. This ramus, containing many unmyelinated fibers, affords a pathway through which fibers arising in the third or lower thoracic ganglia of the trunk may find their way to the upper extremity. In the absence of intact rami such as this, sympathetic fibers which do remain intact in the upper extremity after operation done for such conditions as Raynaud's disease, are most likely fibers which arise at lower levels, ascend in the vertebral canal, and join the nerves of the upper extremity through the intervertebral foramina in the upper thoracic and lower cervical segments.

JOHN MARTIN, M.D.

Wanke, R.: The Scalenus Syndrome, a Contribution to the Static Pathology of the Vertebral Column (Das Scalenussyndrom, ein Beitrag zur statischen Pathologie der Wirbelsaeule). *Ergebn. d. Chir. u. Orthop.*, 1941, 33: 158.

By scalenus syndrome the author understands the characteristic clinical condition occurring in the cervicothoracic segments of the vertebral column and manifesting itself primarily through pathological changes in the region of the so-called posterior scalenus space. Among the symptoms and signs, nervous, circulatory, and muscular manifestations stand in the foreground. The older conception of the cervical-rib syndrome belongs in this category. From a critical standpoint the term cervical-rib syndrome should be applied only to that high-grade form of anomaly in the craniad segments in which an overdeveloped cervical rib encroaches in a strictly mechanical sense on the posterior scalenus space. This concept goes far beyond that of the American investigators who first described the scalenus-anticus syndrome. In the lumbosacral region of the vertebral column the manifold syndrome of lumbago with and without sciatica corresponds to the scalenus syndrome. Studies of the vertebral column indicate that heredity is a fundamental factor.

The important symptom of the scalenus syndrome is pain, first in the form of myalgia. The involved muscles are subject to pain upon pressure, pulsation, and movement. Pain on pressure circumscribed over the insertion of the scalenus anticus on the first rib is characteristic or even pathognomonic. Second, there is pain in the form of neuralgia. This is essentially a pain elicited by stretching, comparable to the Lasèque phenomenon. The third type of pain is causalgic (sympathetic pain) or vascular pain in the arm and hand.

With regard to the development of the syndrome there are:

1. Mechanical factors: marked elongation of the cervical rib; malformation of the first thoracic rib. Complications such as aneurysm formation, thrombosis, and occlusion with ensuing gangrene have not as yet been observed in the scalenus syndrome. Only for such cases does the author acknowledge a justification for the use of the term cervical-rib syndrome.

2. Static factors: the existence of a vertebral anomaly (cervical rib) is not in itself responsible since only from 5 to 10 per cent of these anomalies produce clinical symptoms. There must also be some dynamic or functional condition which initiates muscle spasm. The author believes that the static factor is the most frequent basis for the onset of the scale-

nus syndrome. The static concept should not be interpreted too narrowly, however, as occupation and other factors should be considered as well as similar conditions underlying the lumbago syndrome.

3. Rheumatic factors.

4. Traumatic factors: these were observed 8 times in 53 cases. The author here refers to the lumbago syndrome and the doubtful role of trauma etiologically. Differential diagnostic considerations are given.

In regard to management, conservative treatment includes placing the arm at rest, and in difficult cases a change of occupation, a short course of Vitamin B intravenously, and novocaine infiltration. The operative treatment consists of section of the scalenus-anticus muscle at its insertion on the first rib. This is also the treatment for cervical rib (Adson-Coffey in a series of 36 cases of cervical rib cured the last 4 through simple section of the scalenus muscle). Occasionally it is advisable to resect the lowermost portion of the scalenus muscle. If abnormal adhering bands are present they should be sectioned.

The author studied 53 cases, of which two-thirds were seen in the University Neuro-Polyclinic in Kiel. There were only 3 private cases from his own clinic. The impression was gathered in a certain group of cases that the scalenus syndrome is but one of the manifestations of a complex neuropathic constitution. However, the majority of observations do not fit in with this impression. Cervical-rib anomalies of a striking degree were found in only 8 cases. Deviations of the slightest degree in the structure of the transverse process of the seventh cervical vertebra were noted in 25 cases. Of the 53 cases studied 25 could be followed; of these 13 were treated conservatively and 12 by operation. Among the conservatively managed group there were 5 recurrences which again improved, and 3 recurrences which remained uncured. In 10 of the 12 cases treated surgically, scalenotomy alone was done, while in 2 resection of the cervical rib was done at the same time. Of the latter, 1 was cured and 1 was improved.

The roentgen appearance was that of a cranial variant of the slightest degree (hypertrophic transverse process), in 6 cases; of a small cervical rib in 2 cases; of a normal condition in 3 cases; and that of a caudal variant in 1 case.

Of the 10 patients having scalenotomy, 5 were strikingly free of symptoms after the operation; 4 of them, however, suffered a remission after four weeks so that it was necessary to class them as having recurrences. One case continued a failure, while the 3 others were symptom-free in one and one-half years. In the 5 other operated cases, final freedom from symptoms gradually came about. In this group were those cases with shoulder girdle or palmar atrophy. The period of recovery lasted from weeks to months. In the opinion of the author there is a chronic scalenus syndrome which causes irreversible changes that practically obviate effective therapeutic measures.

(Ramb). JOHN L. LINDQUIST, M.D.

PERIPHERAL NERVES

Robson, S., Blackwood, W., and Cookson, H. A.: A Case of Von Recklinghausen's Disease with Diffuse Neurofibromatosis of the Chorioid. *Brit. J. Ophth.*, 1941, 25: 431.

A young man with generalized neurofibromatosis developed a tumor within the orbit, and upon microscopic study of the removed eye and other orbital contents the pathology was found to be limited solely to the chorioid and the short ciliary nerves. A diffuse, typical neurofibromatosis of these structures was seen. The tumor, containing a certain proportion of large ganglion cells, was to be differentiated from a ganglioneuroma.

The "round or ovoid bodies" of Masson were demonstrated in this tumor, they being the result of transverse section of individual neurofibromatous bundles. It is pointed out that it is a debatable matter whether the underlying pathology of localized neuromas and of diffuse neurofibromatosis is the same. At any rate, these ovoid bodies are apparently no mysterious constituent, but rather a normal finding in the plexiform neurofibromatoses.

JOHN MARTIN, M.D.

Babbini, R. J., and Albertengo, J.: Neurodocitis of the Ulnar Nerve (Neurodocitis del cubital). *Bol. Soc. de cirug. de Rosario*, 1941, 8: 16.

The authors report 5 cases of neurodocitis of the ulnar nerve which they have successfully treated with the transplantation method of Gutiérrez and which were due to deforming arthritis in the first case, old fracture of the elbow in the second, third, and fourth cases, and cyst of the canal in the fifth case. They describe the ulnar nerve and the osteofibrous canal through which it runs at the elbow and state that any change in the normal anatomy of this canal will traumatize the nerve, which finally presents the classical syndrome or paralysis of Mouchet.

In most cases, the syndrome is caused by fracture of the external condyle of the humerus, especially when the fracture occurs during the period of growth of the bone. The course to be covered by the nerve, especially during flexion of the elbow, is increased and the neuritis results from the constant traumatism and stretching to which the nerve is subjected in individuals who, for some reason or other, have the habit of strongly flexing and extending the elbow. Locally, there is more or less deformation and altered mobility of the elbow, depending on the etiology of the case. The remote symptoms are those of neuritis ending in typical ulnar paralysis of the hand. In all cases reported in the literature, the nervous symptoms have appeared many years after the occurrence of the traumatism. The macroscopic lesion of the nerve consists of thickening with fusiform deformation, caused by the presence of fibrous tissue between the bundles.

In some cases, rest has given good results when the symptoms were slight or of recent occurrence. Usually, the treatment must be surgical. Various opera-

tions have been performed by different authors. Supracondylar cuneiform osteotomy was executed by Mouchet to correct the cubitus valgus, and transposition of the nerve was first used by Roux. The most adequate procedure was conceived by Gutiérrez: it puts the nerve in the anterior plane and gives it ample protection.

The muscular transepitrochlear anterior displacement method of Gutiérrez includes a forward curved incision of from 15 to 20 cm. over the canal following the course of the nerve, and section of the antebrachial aponeurosis and of the anterior cubital muscle to the extent of 8 cm.; section of the superficial portion of the epitrochlea with chisel and mallet and, in the upper part, section of the insertions of the epitrochlear mass and partial separation of the muscles inserted on it from the deep muscular plane; transposition of the well isolated nerve in front of the epitrochlea to the anterior muscular plane; replacement of the epitrochlear fragment in its former position and suture of the aponeurosis, which covers it, to the bundles of the internal vastus; and closure of the wound. The elbow is immobilized with a plaster cast in about 90 degrees flexion for one month when bone section has been performed. Lately, the authors have not sectioned the epitrochlea and have immobilized the elbow for twenty days. Physiotherapy and exercises complete the treatment. Follow-up examination as long as three years after the intervention showed excellent functional recovery.

RICHARD KEMEL, M.D.

Adams-Ray, J.: Novocaine Block of the Stellate Ganglion. *Acta chirurg. Scand.*, 1941, 85: 1.

It is postulated that the sensory disturbances (pain, anesthesia) of the extremities following frostbite may be due to one of two factors, or to the combined effect of both: a persistent local ischemia (after the action of the cold has ceased), and/or an injury to the local nervous tissue (as myelin and axis-cylinder degeneration and "interstitial neuritis").

The author has treated protracted disturbances of sensation following injuries of the first and second degree by cold, by means of novocaine blocking of the sympathetic ganglia to the involved segments. In some cases instantaneous and full restitution of sensation was obtained; in other patients the good effects were only temporary. He considers that his results speak in favor of the theory that these disturbances of sensation are due, for the most part, to a local relative ischemia occasioned by a state of chronic vasospasm. He recommends novocainization of the sympathetics as a therapeutic procedure following frostbite injuries of the extremities.

JOHN MARTIN, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Owens, F. M., Jr., and Adams, W. E.: Giant Intracanalicular Fibro-Adenoma of the Breast. *Arch. Surg.*, 1941, 43: 588.

A brief review of the history of the breast tumor commonly known as "cystosarcoma phyllodes" is presented and its gross and microscopic features are detailed.

The clinical history of the condition may simulate that of sarcoma of the breast in that there is rapid growth of a mass in the breast to a large size. However, in almost every case there will be a history of a pre-existing mass in the breast. This remains quiescent for a number of years, then rapidly enlarges and grows to alarming proportions. Some of these tumors weigh as much as 20 kgm., and the average weight of the reported ones is 7.6 kgm.

Enlargement may progress to such proportions that rupture of the skin occurs with herniation of cauliflower-like masses through the opening. Pain is not a prominent symptom, and the only complaints are apt to be the size of the breast or the disability resulting therefrom. Sarcomatous degeneration with metastasis has been known to occur. However, simple amputation of the breast mass is ordinarily successful in effecting a cure, although there may be local recurrence.

The tumor warrants pathological study because of its resemblance to and confusion with sarcoma. Externally the breast is bosselated with variable regions of fluctuation and resistance. When the breast is cut, the tumor is found to consist of huge, well encapsulated intracystic polypoid masses with narrow tortuous clefts, which contain thin fluid ranging in color from yellow to brown. As enlargement progresses, the polypoid masses tend to become flattened and may completely fill the cystic spaces, so that the tumor appears solid. The cut surfaces show great variation, having degenerating zones alternating with areas of solid tissue. Scattered throughout and constituting the majority of the solid parts of the tumor is a soft semitransparent tissue. There is a strong limiting capsule about the tumor, and no invasion of the surrounding tissues occurs.

Histologically the tumor shows variation closely paralleling the gross appearance. The close structural resemblance of the entire tumor to intracanalicular fibro-adenoma is striking. Buds of connective tissue project for varying distances into spaces which are slitlike in character, and none of these numerous slitlike spaces is without epithelial lining. Polymorphism of the stroma is remarkable. Sclerotic plaques composed of cellular areas with dense masses of collagen are scattered among myxomalike regions or areas of edematous infiltration. No bone or cartilage is present. The amount of necrosis and hemorrhage varies in direct proportion to the size of the tumor. SAMUEL H. KLEIN, M.D.

Marques, M. F.: Malignant Lesions of the Breast (Lesões malignas da mama). *Arq. de patol.*, 1941, 13: 97.

The author gives a statistical review and a discussion of the results of treatment of 630 cases of cancer of the breast treated in the four years from January 1, 1932, to December 31, 1935. The five-year results were available for study at the end of 1940.

Of these cases, 619 occurred in women and 11 in men. The number of cases in men was only 1.8 per cent of the number in women, which is in agreement with general statistics, which give the percentage of cases in men as from 1 to 2 per cent. The cases in men are also less malignant and metastasize less frequently. The greatest incidence of cancer of the breast in women is in the decade between forty and fifty years, and in men in the next decade, between fifty and sixty years. In recent years there has been a tendency for patients to come for treatment earlier with a corresponding improvement in the results of treatment.

Trauma does not cause cancer of the breast but may hasten its development or bring to light a preexisting cancer. In 100 of the author's 630 cases there was trauma, but among these 100 cases there were only 20, or 3.17 per cent, in which the trauma could be considered a factor in the appearance of the tumor.

Cancer occurs with equal frequency in the right and left breasts and is located most frequently in the upper-external quadrant. In the majority of cases in which cancer appears in both breasts, metastases are found in one breast, although there are recorded cases of cancer appearing independently in the two breasts. The question of metastasis or independent cancer can be determined by histological examination. The prognosis is very bad in bilateral cancer. There were only 10 cases of bilateral cancer among the author's cases and in 9 of these the second cancer was metastatic.

The question of whether cancer is hereditary has never been definitely settled. Among the author's cases there were 54, or 8.58 per cent, in which there was a history of cancer in the family, either in the present or previous generations. A further study should be made of the question of heredity.

Detailed statistical tables of the results in the various groups of cases are given. The percentage of five-year cures varied from 0 in medullary carcinoma to 68.4 per cent in adenocarcinoma, with 46.1 per cent in scirrhous carcinoma, 37.5 per cent in alveolar carcinoma, and 35 per cent in a combination of scirrhous and alveolar carcinoma. The cases are also reported with reference to the method of treatment and stage of the disease. Special emphasis is placed

on the danger of incomplete extirpation of the cancerous lesion. AUDREY G. MORGAN, M.D.

Roberts, F.: Breast Cancer; A Study of the Train of Events Which May Follow Radical Removal and Postoperative X-Ray Therapy. *Brit. J. Radiol.*, 1941, 14: 269.

The author discusses in some detail the possible explanation for recurrence or metastases in carcinoma of the breast when adequate surgical and radiological therapy has been instituted. The first recurrence appears most frequently in the region of the scar, the skeleton, and the affected side of the neck; less frequently in the pleura and the other breast; rarely in the cleared axilla. A single recurrence is so infrequent, prophylactic irradiation applied to the axilla appears to be superfluous.

It is thought that recurrences in the scar should not be removed surgically since removal does not prevent, but may possibly stimulate the formation of more nodules in the vicinity, whereas irradiation may suppress them and prevent their extension. The author believes that treatment should be administered when localized persistent pain develops in the spine or pelvis even though the x-ray findings may be negative. HAROLD C. OCHSNER, M.D.

TRACHEA, LUNGS, AND PLEURA

Monserrat, J. L.: Esophagotracheobronchial Tuberculous Fistulas (Fistulas tuberculosas esofagotraqueo-bronquicas). *Rev. Asoc. med. argent.*, 1941, 55: 438.

Classification of the cases of fistula between the esophagus and the respiratory passages, reported in the world literature, shows four main groups which include 367 neoplastic, 222 congenital, 41 infectious, and 40 traumatic fistulas. Monserrat considers only fistulas of tuberculous origin. He has found none in the autopsy material of the Faculty of Medicine and in 462 autopsies of tuberculous adults of the Hospital Tornú, but he has discovered fistulous tracts in 3 of 215 autopsies of tuberculous cases from the Hospital for Children. This demonstrates the rarity of aerodigestive fistula of tuberculous origin, and its predilection for children. This rarity is also shown by the fact that only 14 of the 681 aerodigestive fistulas reported in the world literature were of tuberculous nature. The study of the latter cases reveals that the fistula may be due to tuberculosis of the esophagus or the trachea in exceptional cases, and that the most frequent mechanism is that of perforation by tracheo-esophageal evacuation of neighboring caseous lymph nodes. In addition, it would seem that the possibility of aerodigestive fistula formation is greater during the stage of primary infection or during the beginning stage of secondary infection, because of the excessive exudation and the preponderance of lymph-node involvement which characterize these stages of the tuberculous infection.

The autopsy findings in the 3 cases of Monserrat were as follows:

1. A fistulous tract between the lower third of the esophagus and the origin of the left bronchus through a completely caseated lymph node; stage of primary tuberculous infection with original cavern in the form of chancre; lymph-node stage, and miliary and micronodular dissemination.

2. Communication between the esophagus and the trachea through a large caseated lymph node; primary infection complex with Huebschmann's early dissemination; chancre with central softening in the middle portion of the lower lobe; voluminous associated adenopathy; lymph-node stage with miliary dissemination to the peritoneum, liver, kidneys, and spleen; internal hemorrhage from ulceration of the esophagus.

3. Communication between the esophagus and the bronchus through the intertracheobronchial lymph node with the pulmonary caverns; tuberculous bronchopneumonia with macronodular granulations of the kidneys, liver, and spleen; caseous adenitis of the mediastinal and abdominal lymph nodes; tuberculous mediastinitis.

It would seem that the reason for the relatively greater frequency of occurrence of these fistulas in children is the fact that the fistulas are found preponderantly during the stages of lymph-node involvement which accompany or follow the primary tuberculous infection. RICHARD KEMEL, M.D.

Touroff, A. S. W., and Neuhof, H.: The Differentiation Between Acute Putrid and Non-Putrid Pulmonary Abscess. *J. Thoracic Surg.*, 1941, 10: 618.

It is of greatest clinical importance to differentiate between acute putrid abscess of the lungs, and acute non-putrid abscess. The significance of this differentiation lies in the fact that putrid abscesses are essentially surgical conditions, while non-putrid abscesses are essentially non-surgical.

The differentiation clinically is usually not difficult. It depends on the presence or absence of the characteristic fetid odor of the breath or sputum. In rare cases of putrid abscess the odor may be present intermittently or not at all. Bronchoscopy will often assist in clearing up the uncertainty in such cases since a foul odor may be detected through the bronchoscope even though the breath and sputum seem odorless.

Acute putrid lung abscess is usually a unilocular lesion situated peripherally in the lung and surrounded by a narrow zone of pulmonary infiltration. These abscesses develop rapidly (often within a week) and are accompanied by an intense overlying area of pleuritis producing local agglutination of the adjacent pleural surfaces. Putrid abscess appears to be initiated by an anaerobic organism about a particle of aspirated foreign matter. These lesions do not heal readily without surgical interference. The authors believe that lack of oxygenation in the anaerobic infection, as well as resistance of the infecting organisms to chemotherapy, are responsible for the persistence of putrid abscess. Consequently, after a

period of six weeks or so without subsidence of the lesion, surgery is indicated in these cases.

Acute non-putrid abscess is produced by aerobic pyogenes, usually beginning as an area of bronchopneumonia. The pneumonic lesion is usually more extensive and diffuse than that which precedes putrid pulmonary abscess. Areas which are designated as "suppurative" or "necrosuppurative" processes appear later. The non-putrid abscess may assume one of the following forms: (1) an excavation in the midst of, and an incidental part of, an extensive area of necrosuppurative bronchopneumonia; (2) an excavation as the prominent lesion, surrounded by a wide area of bronchopneumonia; (3) "typical" pulmonary abscess surrounded by a rim of infiltration (similar to that discussed under putrid abscess); and (4) multiple scattered lesions existing in various combinations.

The non-putrid abscess often does surprisingly well under chemotherapy (sulfanilamide and its derivatives) and repeated blood transfusions. Postural drainage and bronchoscopy appears to be of little value. Surgery is usually contraindicated, since the cavities often lie deep within the lung and are often multiple or multilocular. The pleura is usually not adherent, and as a consequence spread of infection is likely. Surgery is indicated, however, in certain abscesses, such as described under "3," in which there is a single large cavity surrounded by a rim of infiltration and in which conservative treatment fails to bring about a response. Surgery is urgently indicated whenever an abscess ruptures into the pleural cavity.

The differentiation between acute putrid and non-putrid abscesses thus forms an important basis for appropriate therapy. LUTHER H. WOLFF, M.D.

Betts, R. H.: Carcinoma of the Lung; Bronchoscopic Aspects. *New England J. Med.*, 1941, 225: 519.

Bronchoscopy is the most important method of diagnosis in primary carcinoma of the lung, a disease which now causes from 8 to 18 per cent of all deaths due to cancer. Approximately 75 per cent of such tumors arise in the major bronchi; lesions so situated can be visualized bronchoscopically and specimens can be removed for biopsy.

Bronchoscopic examination is indicated in every patient who is suspected of having a primary pulmonary cancer, with the exception of the patient with obvious widespread metastases. From the bronchoscopic viewpoint pulmonary carcinomas may be conveniently divided into the central and peripheral groups, according to the site of origin of the lesion. The central, or stem-bronchus, tumor arises in the larger air passages and includes all those tumors which can be seen by bronchoscopy. Peripheral tumors arise beyond the proximal segment of a bronchus of the third order and cannot be directly visualized by bronchoscopy.

Of 62 patients with histologically verified pulmonary tumors examined by bronchoscopy, 49 were men, and 13 women. The age distribution was from sixteen to sixty-seven years and the average age fifty-two years. The distribution in the bronchial tree was as follows: right upper, 10; right mainstem, 10; right lower, 9; left lower, 7; left mainstem, 5; left upper, 3; and right middle, 2.

It is thus seen that 67 per cent of the tumors originated on the right side and 33 per cent on the left. The author concludes that bronchoscopy should be considered in every case of unexplained pulmonary symptoms. He believes that primary cancer of the lung should be favorable for surgical treatment when early bronchoscopic diagnosis is made.

HAROLD C. OCHSNER, M.D.

Konjetzny, G. E.: Rubber Tubes Left Behind in Empyema Cavities with Unusual Sequelæ (In Pleuraempyemhoehlen zurueckgelassene Gummirohre mit besonderen Folgezustaenden). *Chirurg*, 1941, 13: 1.

Two cases are reported in which rubber tubes were left in the pleural cavities for eighteen years, in both of which the empyema cavities closed without fistula formation. In the first case, the patient suffered from incessant coughing with profuse expectoration of fetid pus. Operation disclosed several bronchial fistulas which were readily closed. The drain was 7 cm. long. Extensive thoracoplasty, from the third to the tenth ribs, resulted in cure. In the second case, there were frequent hemoptyses and even pulmonary hemorrhage as a result of the drain. At first, a diagnosis of tuberculosis was made, and even when the drain was discovered roentgenologically, operation was not advised because the hemorrhage was thought to come from bronchiectases. Eventual operation revealed a drainage tube 13 cm. long in a putrid empyema cavity, which occupied a pulmonary depression lined with granulation tissue. This gave rise to multiple severe hemorrhages, which were controlled by electrocoagulation. Here, also, there were numerous bronchial fistulas, through which the blood was evacuated externally. The hemoptysis stopped completely when the drain was removed, which indicated that the bleeding did not come from bronchiectatic cavities. Recovery followed here, too, after the resection of four ribs, but with a prolonged convalescence.

On the basis of these cases, the author emphatically urges the secure anchoring of drainage tubes after empyema operations and the use of radiopaque tubing. In addition, he describes his procedure in operating upon persistent old empyema cavities. He avoids schematic incisions and is guided by the extent of the cavities. If a fistula is present, it is demonstrated by contrast dye. He then incises the soft tissues about the fistula, resects two ribs, cuts through the thickened pleura, and then orients himself further. The resection of more ribs is thus determined. The intercostal musculature with its nerves and vessels is preserved as much as possible, as Heller advises in his "shutter plastic". If the pleural scar is very thick (2 cm. and over), he does not use the

Heller method. Heller advises leaving behind the greatly thickened scar fragments in the intercostal muscles. These hard plaques interfere with healing. The author dissects the intercostal musculature sharply from the thickened pleura, and removes the scarred costal pleura from over the entire cavity. This leaves a shallow depression into which a musculocutaneous flap may be laid, directly on to the visceral pleura. Preservation of the intercostal muscles and the intercostal nerves avoids the unpleasant sequelæ of the Schede operation.

(Franz). Leo M. Zimmerman, M.D.

Eglee, E. P., and Wylie, R. H.: Empyema and the Unexpanded Lung Following Artificial Pneumothorax for Tuberculosis. *J. Thoracic Surg.*, 1941, 10: 603.

During the past five years 15,000 patients were admitted to the Bellevue Hospital, New York, with a diagnosis of pulmonary tuberculosis. Of these, 0.91 per cent developed tuberculosis empyema. One hundred forty-three cases of empyema followed artificial pneumothorax, while 24 developed from a spontaneous pneumothorax. Approximately half of the patients who developed empyema after artificial pneumothorax were afflicted with a straight tuberculosis empyema only, as evidenced by the lack of growth of pyogenic organisms upon culture of the pleural fluid. On the other hand, in only one-fourth of those individuals developing empyema after a spontaneous pneumothorax was the pleural fluid free from pyogenic organisms.

The mode of onset and the treatment of the straight tuberculous empyema are analyzed in detail. Tapping, irrigation, thoracoplasty, and thoracoplasty plus thoracotomy were the methods of treatment most generally used in this series. Oleothorax and dye were used less frequently. The authors point out that in those cases in which thoracoplasty plus thoracotomy was performed the mortality rate was approximately 50 per cent, since thoracotomy immediately brings with it pyogenic infection and its complications.

Twenty cases treated with oleothorax were analyzed. The curative results were not good, but the mortality was very low.

A high percentage of patients having pneumothorax and who failed to re-expand the lung developed empyema. The majority of tuberculous empyemas followed a persistent pleural effusion. This persistent pleural effusion should be a warning, and a decision is necessary at this time as to the subsequent treatment in order to avoid tuberculous empyema.

No definite cause could be determined for the onset of mixed tuberculous empyema in 30 of 71 cases. However, in other cases, this type of infection followed internal pneumolysis, refills of air, definite episodes of spontaneous pneumothorax, the Jacobeus operation, and also treatment for tuberculous empyema. The incidence of bronchial fistula proved by the dye method was 50.7 per cent. The seriousness of a mixed tuberculous empyema is shown by the fact that 47.3 per cent of these patients died, 12.0 per cent were benefited, and only 17.5 per cent were cured. The remainder were not benefited. Surgical treatment, particularly thoracoplasty with or without a following Schede operation, resulted in the largest number of cures. The highest mortality occurred in the group which had had drainage only.

Treatment of mixed tuberculous empyema differs according to whether or not a bronchial fistula is present. This is determined by the injection of gentian violet or a similar dye. In cases without bronchial fistula, tapping and irrigation with gentian violet or similar chemicals should be done for a period of a week, since some cases can be rendered sterile by these means. If the sepsis is controlled by this method, it is advisable to perform thoracoplasty without delay in many cases as this procedure is apt to prevent further complications.

In cases not responding to irrigation and gentian violet or other chemicals, prompt and adequate drainage should be performed—in most instances a thoracotomy at the most dependent portion of the empyema cavity. This in turn is to be followed by a graded thoracoplasty as soon as the patient's condition permits, in order to reduce the secreting surface. A Schede thoracoplasty with muscle transplants for closure of the residual bronchial fistula is necessary to bring about the ultimate cure of many of these patients.

Luther H. Wolff, M.D.

HEART AND PERICARDIUM

Linner, B.: Injuries to the Heart Caused by Needles (Verletzungen des Herzens durch Nadeln). *Zentralbl. f. Chir.*, 1941, p. 208.

Among the foreign bodies which occur very rarely in the heart are needles. So far, the entire literature reports only 76 needle injuries to the heart, with 25 recoveries (34.2 per cent) and 51 deaths (65.8 per cent). The death rate is strikingly high. Later reports show better results, with only 1 death in 6 cases. This favorable rate is evidently the result of the fact that a greater number of injured patients are operated upon today than was the case formerly. Needles and particles of needles reach the heart directly or indirectly. Etiologically, 4.5 per cent of the cases are due to murder, 37 per cent to suicide, and 58.5 per cent to accident.

A needle which has penetrated the heart may cause the most serious complications: hemorrhage, injury to the coronary vessels with hemorrhage and cardiac tamponade, injury to the papillary muscle, injury to the sensorium, shock to the nervous system of the heart, and infection. Therefore there should be no delay in removing every needle or fragment of needle which is embedded in the heart; but, of course, opening of the cardiac cavity in new cases must be avoided. Also, a prolonged search for the needle is dangerous, since it is frequently accompanied by serious hemorrhage from the heart. Furthermore, irritation of the endocardium may result in death from cardiac reflex. In older cases in which the

needle proves to be in a favorable position within the heart muscle, life is not endangered.

The point of intervention is determined by the opening through which the needle penetrated, and by the position of the latter. Injuries to the pleura must be avoided, but the operative area must be clearly surveyed. If the cardiac wound does not bleed after removal of the needle from the heart, suture of the small wound may be omitted, since it will be closed completely by overlapping muscular tissue. However, if the muscular wall of the heart was severed completely, a silk suture is indicated in order to avoid the development of aneurysm. Blood in the pericardium should be carefully dabbed up, otherwise it may easily lead to synechia of the pericarditic layers. The following is a case of needle injury reported by the author:

A two-year-old boy, while playing in the room, fell down upon his chest onto the floor. Immediately there was intense pain. Upon investigation his mother noticed a portion of a heavy needle protruding about 1.5 cm. from the middle of the chest. The needle was broken in three pieces, the pointed end having penetrated the wall of the chest while the portion containing the eye was found on the floor. A roentgenogram revealed, at the height of the fourth rib, the outline of the needle fragment which was wedged in the sternum, the greatest portion of which is located intrathoracically. The impression was that the needle had penetrated the heart. Operative intervention under ether followed immediately, with the hope that the needle in the sternum might be grasped and removed, but while the pericardium was reached, the needle fragment was not discovered. The operation was performed on the trochoscopical table and it was observed that the needle moved synchronically with the heart. It was also impossible to remove the needle with the ophthalmological magnet; therefore it became necessary to open the anterior pericardium and to lay open the cardiac area. Even now nothing was visible, but careful palpation disclosed the presence of the needle in the wall of the right ventricle and it was brought to the surface. It had been imbedded about 2 cm. to the right of the sulcus intraventricularis and 1.5 cm. above the diaphragm, and it protruded 1 mm. from the wall of the ventricle. In order not to push the needle deeper into the musculature, a silk suture was applied to the cardiac wall above the visible end of the needle, and this made possible the lifting out and fixing of the heart. The needle was then removed with anatomical forceps. The puncture closed completely and showed no trace of hemorrhage. Recovery was normal and there was no discomfort. An electrocardiogram was negative. (Bode). Hilda H. Wheeler.

Strieder, J. W., and Sandusky, W. R.: Pericardiostomy for Suppurative Pericarditis. *New England J. Med.*, 1941, 225: 317.

During the last half century there have been numerous contributions to the literature dealing with suppurative pericarditis. Shipley and Winslow in 1934 were able to collect a report on 227 cases. The authors report 28 additional cases which have been collected from the literature from January 1, 1934 to January 1, 1940, and to these they add 10 cases of suppurative pericarditis treated by pericardiostomy and hitherto unreported, thus bringing the total of recorded cases to 265.

It is emphasized that the disease is never primary, except in the sense that it occurs as a complication of direct trauma. The diagnosis, however, is frequently missed because the condition is obscured by concomitant thoracic disease. In cases of questionable diagnosis one may have recourse to pericardicentesis or exploratory operation. The authors believe that attempts should be made to do a pericardicentesis before doing a pericardiostomy, although they agree with those who maintain that pericardiostomy is, in itself, attended by little risk.

With chemotherapy as a supplement to pericardiostomy, there should be a further reduction of the mortality. Pericardiostomy should be undertaken early to achieve optimal surgical conditions and probable further lowering of the mortality. Such a policy may involve operating on a certain number of patients in whom the diagnosis cannot be proved by pericardicentesis. In considering the problem of pericardiostomy, one has a choice of several methods of approach: (1) intercostal approach; (2) transsternal approach; (3) approach by resection of one or more costal cartilages, usually on the left; (4) xiphocostal or Larrey's angle approach, with resection of the seventh cartilage; or (5) posterior approach.

Following the pericardiostomy, it is necessary to insure drainage. There is no unanimity of opinion regarding the use of drainage material. The authors are against the insertion of hard rubber tubes and advocate the use of frequent irrigations. They have employed a gravity flow from a height of not more than 50 cm. above the pericardium. The stream of fluid (usually Dakin's solution) is directed to the posterior portion of the sac by means of a No. 14 urethral catheter inserted at the beginning and removed at the conclusion of each irrigation.

Paul Merrell, M.D.

ESOPHAGUS AND MEDIASTINUM

Leven, N. L.: Congenital Atresia of the Esophagus with Tracheo-Esophageal Fistula. *J. Thoracic Surg.*, 1941, 10: 648.

The surgical management of cases of congenital atresia of the esophagus with tracheo-esophageal fistula is a difficult problem. The author has developed a method of management of cases of this type which has proved satisfactory to him.

The most common type of atresia of the esophagus is described as having the upper segment hypertrophied, dilated to 3 to 4 cm. in length, and terminated blindly just above the bifurcation of the trachea, while the lower segment has a fistulous communication with the trachea, usually about 0.5 or 1 cm.

above the bifurcation or more rarely with the bronchus. The symptoms are choking, cyanosis, and regurgitation. Death rapidly ensues due to starvation, dehydration, and aspiration pneumonia. The diagnosis of atresia of the esophagus is readily made on the typical history; viz., obstruction of the passage of a catheter at 10 to 12 cm. from the alveolar margins, and roentgenological visualization of the blind pouch with instillation of lipiodol, or by esophagoscopic examination. The presence of air in the stomach in cases of atresia of the esophagus indicates a fistulous communication with the lungs.

The treatment of these cases has been gastrostomy, jejunostomy, gastrostomy plus jejunostomy, ligation of the cardiac end of the esophagus plus gastrostomy, transthoracic ligation of the fistulous communication with the trachea with gastrostomy, and closure of the fistula at the junction with the trachea, together with the connection of the esophageal segment by a tube, or anastomosis of the segments by a modified Murphy button or direct anastomosis and endobronchial stenosis of the fistula plus gastrostomy.

The author's method consists of a procedure which may be divided into three simple stages and which offers a greater chance of success. A preliminary gastrostomy under local anesthesia is done through an upper left rectus incision, and a catheter is brought out through a stab wound to the right of the midline. It is important to pass the catheter through the pylorus into the duodenum or jejunum. After the patient recovers from this procedure the fistulous communication to the trachea is ligated. This is done through an oblique incision after which the entire fourth rib on the right side is removed, which exposes the esophagus. The esophagus is then crushed by a forceps and doubly ligated with heavy silk. A rubber catheter is left in the extrapleural space and brought out through a stab wound in the fifth intercostal space. The chest is closed tightly. After the operation, suction of 12 mm. of mercury is applied to the catheter to assure expansion of the lung and obliteration of the extrapleural space. The third-stage operation consists of mobilization of the upper segment of the esophagus through an incision anterior to the left sternomastoid muscle. The tip of the blind pouch is brought out through a small incision below the left clavicle and opened in three days, which completes the cervical esophagostomy. At a later date an antethoracic esophagoplasty should be performed to establish continuity of the gastro-intestinal tract.

By dividing the operative procedure into these three stages the major problems have been successfully handled. J. DANIEL WILLEMS, M.D.

Wu, Y. K., and Loucks, H. H.: Surgical Treatment of Carcinoma of the Esophagus. *Chinese M. J.*, 1941, 60: 1.

For some undetermined reason, carcinoma of the esophagus is especially prevalent among the Chinese. According to the statistics compiled by Kevan in 1937, this lesion constitutes 51 per cent of all neoplasms of the alimentary tract seen (exclusive of those involving the oral cavity and pharynx).

The authors performed surgical resection upon 3 cases of carcinoma involving the lower end of the esophagus or both the lower end of this organ and the cardia of the stomach. Two cases were cured.

The various phases of the subject of surgical treatment of carcinoma of the middle and lower portions of the esophagus are discussed. These include the selection of patients, pre-operative preparation, anesthesia, operative technique, and post-operative care. SAMUEL H. KLEIN, M.D.

MISCELLANEOUS

Bullo, E.: Diaphragmatic Hernia on the Right Side (L'ernia diaframmatica destra). *Radiol. med.*, 1941, 28: 265.

Diaphragmatic hernia is much less frequent on the right side than on the left, there being only about 1 case of the former to 8 or 10 of the latter. The anatomy of the region and the different types of hernia, such as true and false, congenital and acquired, traumatic and non-traumatic, are discussed. The roentgen differentiation between hernia and relaxation of the diaphragm is also considered.

A case of diaphragmatic hernia on the right side in a man sixty-five is described; the diagnosis was made by roentgen examination. Part of the transverse colon was herniated into the thoracic cavity. If the opening is large, the liver may herniate into the thorax and, strangely enough, this condition is not incompatible with life and even with good health.

The roentgen signs on which the diagnosis in this case was based were the high position of the viscera in the thorax and their ready mobility, the differences in the appearance of the roentgenogram with the patient lying down and standing, and on different days, and the presence of a constriction of the colon at the site where it passed from the abdomen into the thorax. Some signs that have been described by roentgenologists are very inconstant, such as the visibility of the diaphragm beneath the herniated viscera and the visibility of the lung outline through the loops of intestine in the thorax. The sign of a double outline, that is, a line parallel to the curve of the diaphragm, which has been given as a sign of relaxation of the diaphragm, is seen also in hernia. The author does not think it possible or necessary to make a roentgen diagnosis of the type of the hernia, whether true or false, congenital or acquired. It is sufficient to establish the fact that there is a hernia, and to determine what organs are contained in it and their position, so that operation may be performed with assurance and safety if it is necessary. AUDREY G. MORGAN, M.D.

Faxon, H. H. The Logical Approach to Subphrenic Abscess. *Am. J. Surg.*, 1941, 54: 114.

There are six anatomical spaces where subphrenic collections of pus may form. They are the right pos-

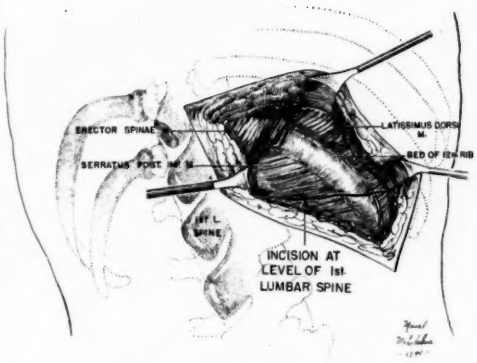

Fig. 1. Drawing of the initial steps in the retroperitoneal type of operation for a right posterior or inferior space infection. Note that the deeper dissection is at a level of the first lumbar spine rather than along the bed of the twelfth rib.

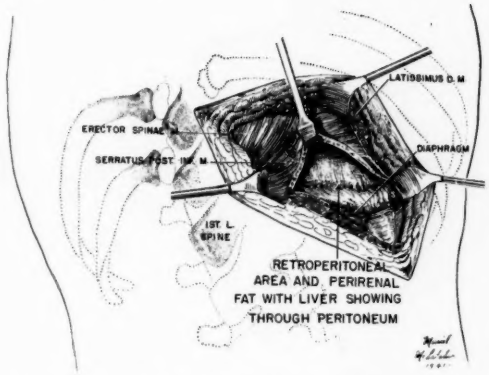
LATISSIMUS D. M
ERECTOR SPINAE M.
SERRATUS POST. INF. M.
DIAPHRAGM
1ST L. SPINE
RETROPERITONEAL AREA AND PERIRENAL FAT WITH LIVER SHOWING THROUGH PERITONEUM

Fig. 2. Drawing of a later stage in the retroperitoneal type of operation for a right posterior or inferior space infection. Note that the lower fibers of the diaphragm have been cut across but that the peritoneum has not been incised.

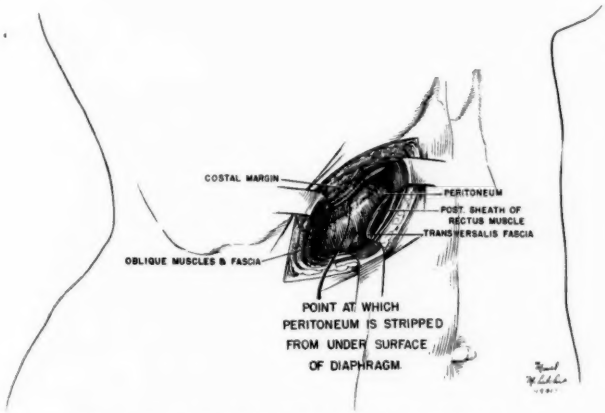
COSTAL MARGIN
PERITONEUM
POST. SHEATH OF RECTUS MUSCLE
TRANSVERSALIS FASCIA
OBLIQUE MUSCLES & FASCIA
POINT AT WHICH PERITONEUM IS STRIPPED FROM UNDER SURFACE OF DIAPHRAGM

Fig. 3. Drawing of the initial steps in the retroperitoneal type of operation for an anterior space infection. Note that the posterior fascial layers must be incised before the peritoneum can be stripped from the undersurface of the diaphragm. (Courtesy of American Journal of Surgery.)

terior superior, the right anterior superior, the right inferior, the left superior, the left anterior inferior and the left posterior inferior.

Subphrenic infection is a complication frequently of operations on the appendix, stomach, duodenum, liver, and bile passages.

The most logical approach to a subphrenic abscess is the retroperitoneal operation. By this type of operation contamination of the peritoneum or pleura, which doubles the mortality rate, is avoided.

The technique of the operation is well shown by the illustrations. JULIAN A. MOORE, M.D.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Uebermuth, H.: Influenza and Peritonitis. References to Acute Serous and Chronic Fibroplastic Peritonitis (Grippe und Bauchfellentzuendung. Beziehungen zur akuten seroesen und chronischen fibroplastischen Peritonitis). *Ergebn. d. Chir. u. Orthop.*, 1941, 33: 60.

The author first of all reviews the literature on influenza and peritonitis. He then continues briefly on the secondary peritonitis resulting from extension through the diaphragm and intestine and on the metastatic peritonitis from illness of the abdominal organs caused by lymphatic spread. Influenzal pharyngitis, angina, and bronchitis can spread by way of the blood vessels to produce peritonitis. In this type of peritoneal suppuration, streptococci were predominantly demonstrable, never Pfeiffer's influenza bacilli.

Uebermuth describes in detail a third form, primary true influenzal peritonitis. This form is characterized by rapid development of a peritoneal inflammation without perceptible disease of other organs, except for transient catarrhal phenomena in the throat, on the tonsils, in the trachea, or in the conjunctivæ; or with fleeting enteric phenomena as an initial symptom. Pain in the limbs and back, chills with vomiting, and headache with more severe body fatigue are also frequent. The abdominal phenomena are very often manifested in the beginning in the left side of the lower abdomen or in the middle of the lower abdomen. In addition, the leucocyte count in the beginning of an influenzal abdominal illness is reduced to from 4,000 to 6,000. It is in the later phases that considerable elevation up to 30,000 white blood cells is often present. With influenzal peritonitis in the true sense the disease is confined to the lower intestinal segments, especially the terminal ileum where the oldest inflammatory aggregation, the most severe erythema, and occasionally also subserous bleeding are found. Tenderness to pressure and rigidity are also present in the left side of the lower abdomen. The early stages may be hemorrhagic or serous in nature. Ready transition to quite purulent forms occurs. While the serous forms always heal completely, the streptococcal cases end fatally almost without exception. Very often, in the beginning, no bacteria are demonstrable. With the quite purulent forms death is prevented from occurring only if localization takes place. Intra-abdominal abscesses form predominantly in the left side of the lower abdomen.

Among the large number of patients with peritonitis in the Leipzig University Clinic there were 26 clouded or cryptogenic cases. A part of the so-called cryptogenic peritonitis probably really represents a true influenzal peritonitis. By absorption and organization inflammatory exudate can progress to a final condition of chronic fibrous peritonitis. With fibroplastic peritonitis come veil-like adhesions of the lower small intestine. These adhesions are largely firm mother-of-pearl-like glistening membranes ("sugar icing bowel"). By encapsulation of intestinal loops the phenomenon of ileus occurs. The membranes consist of a superficial cell-poor and vessel-poor sclerotic connective tissue of hyaline appearance and an underlying cell-rich tissue, which explains the origin from a fibrinous effusion. Accordingly it appears that fibrin becomes repaired by connective tissue. (GEBELE). EDWARD W. GIBBS, M.D.

GASTRO-INTESTINAL TRACT

Bohrer, J. V.: Massive Gastric Hemorrhage; With Special Reference to Peptic Ulcer. *Ann. Surg.*, 1941, 114: 510.

Massive gastric hemorrhage occupies a unique place for testing the diagnostic acumen of the surgeon and the facilities of the hospital to meet a real crisis. Rapid exsanguination by hematemesis is a combination of concealed or silent hemorrhage with all evidence of the shock of external hemorrhage. Penetrating ulcer is unquestionably the most frequent cause of this condition. The hemorrhage may be totally concealed because of the location of the ulcer, or it may bleed into the stomach and be followed by hematemesis.

Before proper treatment other than blood transfusion can be instituted, a differential diagnosis must be made. A previous history of gastric distress may suggest ulcer, but a history of ulcer may not be obtained. In about 10 per cent of all cases of profuse gastric hemorrhage, the history and physical examination will be inconclusive. Early liver cirrhosis with bleeding esophageal varices will account for some instances of severe hemorrhage.

During the ten-year period from 1931 to 1940, inclusive, 40,825 patients were admitted to the Knickerbocker Hospital. These included 456 cases of peptic ulcer, of which 182 were admitted for gastric hemorrhage. Of 80 patients suffering from massive gastric hemorrhage 14 died, a mortality of 17.5 per cent. This may account for the belief that massive gastric hemorrhage is relatively uncommon and causes few deaths.

THE PATHOLOGY OF BLEEDING ULCERS

Bleeding from an ulcer connotes activity even though hemorrhage is the first symptomatic evidence of its presence. Erosion of the mucosa may produce moderate bleeding and may cause massive gastric hemorrhage, but severe hemorrhage is more frequently the result of the erosion of a vessel of appreciable size. The chronic penetrating type of ulcer may occur in any part of the stomach or duodenum. The general belief that perforating ulcers do not bleed is not true. The posterior penetrating type of

ulcer with a necrotizing base in the head of the pancreas is most provocative of massive gastric hemorrhage. In this location, a branch of the superior pancreaticoduodenal artery frequently becomes eroded. In the ulcer crater, the sclerotic artery is found terminating with an open stoma. Chiesman found a mortality of 74 per cent in a group of 62 patients who had bled for two or more days. Autopsy showed an open vessel in 45 of the 46 patients in this group. An eroded artery was frequently found in the Knickerbocker Group at operation or at autopsy. This was also the common finding in the group in which questionnaires were sent out.

SYMPTOMS

A small percentage of the ulcers belong to the silent type in which perforation or bleeding is the first indication of their presence. Heavy lifting while at work, recent respiratory infections, or alcoholic excesses associated with emesis are frequent exciting causes. If massive bleeding takes place, syncope followed by hematemesis or the passage of one or more bloody stools is not uncommon. Unfortunately the initial symptoms rarely indicate the degree and extent of hemorrhage. An accurate estimate of the severity of the hemorrhage may be made from the rapidity of the pulse, the low blood pressure, and the symptoms of shock. Without a definite history of ulcer, the true cause of the hemorrhage, whether from esophageal varices, gastric polyps, carcinoma, gastritis, redundant gastric mucosa, or simple hemorrhagic diathesis cannot be determined.

GENERAL MANAGEMENT

All patients with gastric bleeding are seriously ill and must be given absolute bed rest with morphine to allay fear and restlessness. Pulse and blood pressures should be frequently recorded. Shock must receive appropriate treatment. Ice caps to the epigastrium are definitely prohibited. A Levine tube should be passed well into the stomach through the nostril for aspiration of liquid blood and lavage with saline solution until the stomach is free of blood clots. The removal of this blood prevents nausea and vomiting. If, after the stomach is empty, bright red blood continues to be aspirated, it is evident that hemorrhage is still active and probably arterial, which indicates immediate operation for relief. The use of the Levine tube is therefore not only of therapeutic value but also of great diagnostic import. Severe straining and reverse peristalsis of the stomach is inhibited by removal of the nauseating blood. Feeding is easily accomplished.

The typing of blood and accessible donors are essential in all cases of massive hemorrhage. Diet is as important to prevent recurrent ulcer in the postoperative patient as it is for healing the ulcer in the conservatively treated patient. It is becoming generally accepted that a starvation diet should be abandoned. An acceptable diet that will absorb acid and prevent the action of digestive juices on the ulcer, and especially on the clot in the eroded vessel, is very important. At present, the Andresen diet is being used. Blood chemistry should be followed.

TRANSFUSIONS

While transfusion of blood during an attack of massive gastric hemorrhage is now generally accepted, a small minority still believe that transfusion is contraindicated for the reason that elevation of the blood pressure may dislodge the clot in the bleeding vessel. No proof of this theoretic objection has ever been produced. On the contrary, there is much evidence to support the advantages of giving proper amounts of blood during the acute anemia. Severe grades of anemia are provocative of certain morbidities and mortalities. Undiluted fresh whole blood should be employed; it is preferable to citrated or banked blood.

MORTALITY

In 1935, Westermann reported on the appalling mortality from conservative treatment and suggested that some of the patients should be surgically treated. At this time some of his colleagues still were inclined to favor conservative treatment, in view of the operative risk. Since 1938, surgery has had an increasing number of advocates.

Replies to a questionnaire sent out by the writer indicate that fully 75 per cent of the surgeons strongly believe that surgery has a definite place in the treatment of massive gastric hemorrhage. The remaining 25 per cent are as strongly convinced that this condition is entirely a medical problem and that surgery should be deferred until the patient has recovered from his exsanguination. In 112 of the author's series of 1,556 cases of peptic ulcer, operation was done during the acute bleeding period. The remaining 1,444 were treated conservatively. The mortality for the entire group of 1,556 cases was 17 per cent.

In the Knickerbocker and "Questionnaire groups," 160 patients were operated upon during the bleeding period, many of them after prolonged bleeding. Of these, 112 had gastrectomies, either a Polya, a Billroth II, or some type of resection. Twenty of these patients died postoperatively, either from the operation or from postoperative complications, such as pneumonia. This gives a mortality of 17.8 per cent for all types of ulcers.

There were 6 of 23 patients with gastric ulcer more than forty-five years old who died, a mortality of 26 per cent. This compares favorably with the conservatively treated cases. Among 94 patients in the same age group there were 27 deaths, a mortality of 28.7 per cent. Of the group of patients with duodenal ulcer who were more than forty-five years old, 55 were operated upon, with 8 deaths, a mortality of 14.5 per cent; while in the conservatively treated group of 199 patients there were 44 deaths, a mortality of 22 per cent. Finsterer performed 71 gastrectomies upon patients with bleeding ulcer with a mortality of 4.2 per cent.

CONCLUSIONS

Gastrectomy is the operation of choice, both for the control of hemorrhage and for an ultimate cure. It is often more difficult to accomplish in cases of duodenal than in cases of gastric ulcer. Local excision of gastric ulcer combined with gastro-enterostomy apparently gives a satisfactory result. Early operation before repeated hemorrhage occurs is essential for a lowered mortality. Vitamins B and C are valuable postoperatively.

JOHN W. NUZUM, M.D.

Soutter, L.: Shock in Perforated Peptic Ulcer. *Surgery*, 1941, 10: 233.

In a consecutive series of 335 cases of perforated peptic ulcer observed at the Bellevue Hospital from 1929 to 1938, there was found a form of circulatory collapse marked by lowered blood pressure, weak rapid pulse, subnormal temperature, pallor, sweating, and coldness of the skin; however, every sign was present in only 3 instances. One of the 3 patients had hemorrhages, another was syphilitic with a poor cardiac reserve, and the third had the perforation for three days before admission and showed frank peritonitis at operation. A subnormal temperature was present in 16.7 per cent, pulse rates above 100 were noted in 38.5 per cent, a systolic pressure of 100 or less was noted in 11.6 per cent, and sweating, cold or pale skin, or all of these conditions were noted in 16.7 per cent of the cases. There were 20 cases (6 per cent) that combined a systolic pressure of 100 or less with either a rapid pulse (above 100) or a subnormal temperature, or pallor, or several of these. The 3 cases noted are included in this group. Of the remaining 17 cases, 4 had no other etiological factor than perforation upon which the signs could be blamed. They did not present a very convincing picture of shock, however, for the blood pressures were above 90, the pulse rates between 78 and 108, and the temperatures ranged from 97.8 to 100.8 degrees. Only 1 patient was listed by an observer as being in shock and 1 other was said to be cool and sweating. Of the 13 remaining, 1 was drunk, 9 had well developed signs of peritonitis, 2 were suspected of having peritonitis, and another was anemic from blood loss. All of these 13 and the 3 profoundly shocked patients died. It appears that true shock is rare in perforated peptic ulcer, but that in the presence of some signs of it there is probably an additional causative factor to be suspected. Peritonitis is the chief of these, it being present in 12 patients of this group of 20. In a study of the relationship between shock and the duration of the perforation it did not appear that any conclusion could be drawn since there was no definite period in which signs of shock were more apt to be found. Also, in the group in which mild shock was present there was no marked preponderance of late cases over early ones, or *vice versa*. The size of the ulcer and the quantity of exudate also did not appear to influence the development of shock. The existence of shock in the presence of a perforated peptic ulcer would suggest some complication such as peritonitis especially in the late cases. The treatment was for shock as well as for the underlying disease. The outlook was grave, particularly in the late cases in which signs of shock were synonymous with infection and a consistent prelude to death.

MANUEL E. LICHTENSTEIN, M.D.

Bird, C. E., Limper, M. A., and Mayer, J. M.: Surgery in Peptic Ulceration of the Stomach and Duodenum in Infants and Children. *Ann. Surg.*, 1941, 114: 526.

Because of the general impression that peptic ulceration in infants and children is excessively rare, the writers have made a careful search of the literature for operative reports confined to infants and children. The cases total 119 and include 1 of their own. They have also accumulated reports of 124 cases in which no operation was undertaken, and in most of these instances the diagnosis was confirmed at autopsy.

An analysis of the collected cases shows that ulcers in the newborn, by which is meant infants in whom the symptoms become outstanding within the first two weeks of life, have special characteristics: the great majority that are recognized bleed seriously or perforate, or do both; in many the onset is precipitous without recognizable premonitory symptoms or signs; with few exceptions the lesions are acute, without cellular reaction or bacterial invasion; because of the sudden fulminating symptoms, very few of these newborn patients are subjected to operation; and the duodenal ulcers outnumber the gastric in the ratio of 2 to 1. Peptic ulcers have been shown to occur even *in utero*.

A rather complete examination of the literature forces the conclusion that there is a considerable number of infants and children who at one time or another have peptic ulcers of the stomach or duodenum. Up to and including the age of adolescence there exists a large number of unrecognized ulcers of a potentially serious nature. Many of these lesions may be acute and superficial and heal rapidly with an altered regimen. In a few cases, the symptoms persist and barium examination may show a definite ulcer crater. Roentgenological examination is indicated more frequently in the young child. Operation is indicated when chronic hemorrhage, perforation, or pyloric occlusion presents itself. Children like adults are subject to recurrent gastrojejunal ulceration. Recovery is reported subsequent to the closure, thirty-four and one-half hours after birth, of a perforated duodenal ulcer in a colored infant. The child remained well six years afterward.

JOHN W. NUZUM, M.D.

Walters, W., and Cleveland, W. H.: Results of Partial Gastrectomy for Bleeding Duodenal, Gastric, and Gastrojejunal Ulcer. *Ann. Surg.*, 1941, 114: 481.

Ninety-seven (approximately 87 per cent) of 112 traced patients treated by partial gastrectomy for

bleeding peptic ulcer presented satisfactory results, without further hemorrhages and with relief of the ulcer type of distress. One patient had a fatal postoperative hemorrhage. If cases in which the pylorus was not removed or in which entero-anastomosis was performed are excluded, the satisfactory results reach 91.5 per cent. Of the 13 per cent of patients in whom the results were classified as unsatisfactory, 6 (5.4 per cent of the total) were living reasonably normal lives at the time this study was made, although evidence of recurrent ulceration had been present at some period.

Satisfactory results without subsequent hemorrhage or without subsequent ulcer type of pain were obtained by partial gastrectomy in 94.5 per cent of the bleeding duodenal ulcers. All primary resections for bleeding duodenal ulcer relieved the patients except the 2 in whom the pyloric antrum was not removed.

Ninety-five per cent of the patients treated by partial gastrectomy for bleeding gastric ulcer presented satisfactory results. Five per cent had further pain; none had further hemorrhage. In all these cases, entero-anastomosis was not performed and the pyloric antrum was removed at operation.

Seventy-six and one-tenth per cent of the patients who had bleeding jejunal ulcers and were treated by partial gastrectomy presented satisfactory results. Seventy-eight and three-tenths per cent had no further hemorrhage, and 1 (2.2 per cent) had further pain without hemorrhage. In 8.8 per cent of the cases of bleeding jejunal ulcer, entero-anastomosis was performed with the gastric resection, or the pyloric antrum was not removed; the subsequent ulcer type of pain and bleeding occurred in all. In an additional 8.8 per cent, the Billroth I-type of resection was performed for bleeding jejunal ulcer, and subsequent bleeding and ulcer type of pain occurred.

The pyloric antrum should be removed in the course of all gastric resections for bleeding peptic ulcer, but entero-anastomosis should not be performed because it tends to prevent a maximum reduction of the gastric acidity.

From 1932 to 1936, inclusive, the risk of partial gastrectomy for bleeding peptic ulcer was 10.3 per cent in the 135 cases. In the 42 cases of bleeding duodenal ulcer it was 7 per cent. In 1940, the risk of partial gastrectomy for bleeding peptic ulcer was 4.1 per cent in 119 cases; for bleeding duodenal ulcer it was 6.8 per cent in 73 cases, and there were no deaths among 46 patients who had partial gastrectomies for bleeding gastric ulcer (17), bleeding gastric and duodenal ulcer (3), jejunal ulcer (25), and bleeding gastrojejuno colic fistula type of ulcer (1). The improvement in operative risk had been attained by improvement in the pre-operative and postoperative care, the use of chemotherapy, a better understanding of vitamin deficiencies, more rigid indications for partial gastrectomy, and improvement in postoperative care of lung complications.

The results support the contention that partial gastrectomy offers the best chance of cure or amelioration of symptoms of bleeding peptic ulcer and the best prophylaxis against further hemorrhage.

With the elimination of procedures which have proved of least merit, such as failure to remove the pyloric antrum with the resected portion of the stomach, and entero-anastomosis, and with the less frequent use of the Billroth I-type of procedures, results should be improved. Thus, in the 119 cases in which resections were performed for bleeding peptic ulcer at the Mayo Clinic in 1940, the pyloric antrum was removed in all but one, and the posterior Pólya type of resection and anastomosis was employed in 94.1 per cent. The results for 1940 should be superior to those of the 1932 to 1936 period, when 7 pyloric antra were not removed, and only 75 per cent of the partial gastrectomies were of the posterior Pólya type.

Aird, I.: Morbid Influences in Intestinal Obstruction and Strangulation. *Ann. Surg.*, 1941, 114: 385.

Intestinal obstruction remains one of the most rapidly lethal of surgical diseases. In a recent series of 2,150 cases of acute intestinal obstruction and strangulation, when herniæ and tumors were excluded, there remained 632 cases with a fatality rate of 45 per cent. The disease still remains a challenge both to the surgeon and the experimentalist.

Two recently new powerful weapons have been added to our therapeutic armamentarium—the nasal suction tube and the intravenous drip. Nasal drainage and the intravenous administration of saline solution are beneficial in most cases of intestinal obstruction. In cases of strangulation, on the other hand, the need for operative relief is much more urgent. It is often difficult to distinguish simple occlusion from strangulation clinically, and to persist with conservative measures where strangulation exists is to court disaster. A twenty-four-hour delay may spell the difference between viability and gangrene.

In spite of nasal-suction drainage and the intravenous administration of saline solution, with the chloride content of the blood at or near a normal level, and after the completion of the operation, too frequently a fatality results. One is forced to conclude that depletion of the chlorides and water is not the sole lethal factor.

In high occlusion of the small bowel, the cause of death is dehydration, hypochloremia, alkalemia, and azotemia. These can be effectively controlled by nasal-suction drainage and the forced intravenous administration of saline solution by the drip method. Operation may be delayed and conservative measures continued for many days provided the cause of obstruction is known and provided the presence of a strangulating element can be definitely excluded.

In untreated cases of low occlusion of the small bowel, both in the experimental animal and in man, death does not usually occur until three or four weeks after the onset of obstruction. In these cases, the suspended absorption of water, salts, food materials, and other constituents of intestinal content is sufficient to explain death. Gross congestion of the bowel

may be considerable and may lead to the depletion of the blood volume. Perforation of the distended bowel with peritonitis is a relatively frequent cause of death in the animal or man whose occlusion remains unrelieved by operation. The deaths from low occlusion of the small bowel today are nearly all postoperative deaths. The toxic effect of sudden relief of a long-continued distention of the bowel has been demonstrated by experiment.

In occlusion of the colon, perforation and peritonitis are responsible for most of the deaths. In long-continued occlusion of the colon, the same factors probably operate as those in low obstruction of the small intestine.

In closed-loop obstruction the cause of death depends on the infectivity of the contents of the loop. With heavily infected closed loops, death results from peritonitis and perforation. Splanchnic congestion is usually more serious in closed-loop occlusion. In strangulation of short loops of bowel, death results from perforation and peritonitis. In long-loop obstruction due to strangulation, death is due to diminution of the effective circulating blood, as a result of blood loss into the lumen and wall of the strangulated intestine and into the peritoneal cavity.

With strangulation of loops of medium length of bowel, the cause of death appears to be the absorption of toxins. In the early stages of strangulation, this occurs by way of the lymphatic routes; later it occurs by way of the peritoneal cavity. The depressor effect of the sudden relief of any form of intestinal distention is seen in an exaggerated form upon sudden relief of a long-continued strangulation.

JOHN W. NUZUM, M.D.

Macmanus, J. E.: Perforations of the Intestine by Ingested Foreign Bodies. Report of 2 Cases and a Review of the Literature. *Am. J. Surg.*, 1941, 53: 393.

Two patients presented foreign bodies which had perforated the intestine. The pre-operative diagnoses were strangulated inguinal hernia and acute appendicitis. The patients presented a metallic wire and a toothpick, respectively. Both recovered.

The review of the literature showed 93 cases divided more or less evenly between the sexes, with 50 per cent in the first three decades. In 46 per cent of the cases the foreign bodies were metallic, while the remainder were composed of various materials with a predominance of bones of various types.

Most of the perforations occurred in the lower ileal and cecal regions, with some in the region of Meckel's diverticulum, and 34 in the appendix. The duration of symptoms was difficult of accurate appraisal. It varied from three hours to twelve years, and there was little correlation between the duration of the symptoms and their severity.

Clinically, the cases fell into 5 different groups: (1) early localized peritonitis, (2) indurated inflammatory tumors, (3) abscesses, (4) general peritonitis, and (5) hemorrhage. The gross mortality was about 25 per cent, with a great difference between those cases seen before 1900 (53.5 per cent) and those seen later (10 per cent). JOHN W. EPTON, M.D.

Liedberg, N.: Traumatic Subcutaneous Rupture of the Intestine (Zur Klinik der traumatischen subcutanen Darmruptur). *Acta chirurg. Scand.*, 1941, 85: 325.

The present report is based on a review of the literature and 52 of the author's own cases. The latter represent the incidence of traumatic intestinal rupture occurring in the Surgical Clinic at Lund over a period of thirty years from 1910 to 1929, inclusive.

The existence of hernia, whether the sac contains bowel or not at the time of the accident, seems to be a predisposing factor in intestinal rupture. The author enters into a detailed discussion of the mechanism and modus operandi of trauma resulting in subcutaneous rupture. According to Moty this form of injury may result from compression, bursting, and tearing.

Several illustrative cases are reported in detail. This injury may affect both sexes at any age but is most common in the male from the second to the fifth decade, because he is more exposed to hazardous activities and occupations. In rural districts a kick by a horse is a frequent cause of subcutaneous intestinal rupture.

Successful treatment depends on early diagnosis before peritonitis has become widespread. X-rays may be of diagnostic aid in questionable cases if free air can be demonstrated in the peritoneal cavity.

The surgical procedure depends on the conditions found in the individual case at the time of operation. In the author's series there was an immediate mortality of 36 per cent. In the 26 cases operated upon during the first six hours after the accident the mortality was 23 per cent. HARRY A. SALZMANN, M.D.

Sharp, G. S.: The Radiation Treatment of Cancer of the Rectum. *Am. J. Roentgenol.*, 1941, 46: 207.

From 1932 to 1936, inclusively, 28 cases of cancer of the rectum were treated by the author with various forms of radiation therapy. In 13 patients, 7 of whom were operable, a complete eradication of the carcinoma was attempted, while in the remaining 15 palliative roentgen therapy constituted the method of procedure from the beginning. Of the 13 patients receiving radical treatment, 7 (approximately 50 per cent) are free of the disease, or post-mortem examination failed to disclose evidence of cancer. Two additional patients are living with disease five and eight years later, respectively. In the palliative group, the survival was from one to thirty months with the exception of 1 patient who is still well after four years.

Four cases are described in detail and in connection with them the various phases of dosage are considered. In general, the radiation was divided into 3 methods: (1) external irradiation with high voltage roentgen rays; (2) intrarectal radiation plus external irradiation, and (3) perirectal radiation plus intrarectal and roentgen irradiation.

The external irradiation was carried out with the following technique: 200 kv., 15 ma., 80 cm. distance, Thoraeus filter equivalent to 2 mm. of copper and a half-value layer of 1.9 mm. of copper; 2 anterior portals of 15 by 15 cm. each, and 2 posterolateral portals of 15 by 10 cm. each, and occasionally a fifth perineal portal 10 cm. in diameter. A tumor dose of 1.64 erythemas was delivered through the posterior portals and of 1.06 erythemas through the anterior portals, for a total of 2.7 erythemas. In case that a perineal portal was also used, an additional erythema was delivered to the tumor through this portal. The physical dose amounted to 300 roentgens (in air) daily or on alternate days until approximately 900 roentgens were given to each portal. If the response was satisfactory, the irradiation was continued until from 1,500 to 1,800 roentgens reached each portal.

When intrarectal radiation was used in addition to the external roentgen therapy, the latter was pushed up to the limit of skin tolerance (from 1,800 to 2,000 roentgens). The intrarectal radiation then was carried out under spinal anesthesia by implanting through a large operative proctoscope with the aid of trocars over 20 radon seeds directly into the carcinoma. The number and location of the seeds were determined for the uniform delivery of 7 or 8 erythema doses throughout the tumor. In 5 of the advanced cases intrarectal surface radium applications were used with very little benefit.

In 1934 a combination of intrarectal radon seeds and perirectal radium needles was instituted for the interstitial radiation, which was given in addition to the external roentgen therapy. The surgical procedure for the perirectal radium implantation was performed under spinal anesthesia, with the patient in lithotomy position. Stab incisions were made 1 cm. away from the mucocutaneous junction and 2 or 3 needles were inserted through each incision. The left index finger was placed intrarectally as a guide. The needles were placed parallel to one another and 1 cm. apart. Their total lengths were 2.7, 4.0, and 6.0 cm., respectively; their contents 2, 4, and 8 mgm., in tandem or in series; and they were filtered with 0.5 mm. of platinum. An attempt was made to divide the total dosage into equal parts of the 3 types of radiation used: e.g., 3 erythema doses of roentgen rays, followed by 3 to 4 erythema doses delivered by radon seeds into the tumor, and finally, at the time of the latter or preferably two to four weeks later, 3 to 4 erythema doses of perirectal radium. The method has given such good results that its general use is now recommended. Colostomy was performed on 4 of the 28 patients. T. LEUCUTIA, M.D.

Pennington, M. S.: A Case of Diaphragmatic Eventration, Segmental Megacolon, and Multiple Congenital Dystopias (Un caso de eventración del diafragma, megacolon segmentaria y distopias multiples congenitas). *Arch. argent. de enferm. d. apar. digest.*, 1941, 16: 484.

Pennington presents a series of roentgenograms showing the anomalies found in a woman, aged fifty-four years, who had only slight attacks of intestinal obstruction which responded to the simple introduction of a rectal tube. These attacks were probably due to a torsion or angulation of the narrow portion of the rectum between the latter and the dilated loops of the segmental megacolon. The patient was in excellent health between attacks and felt only a slight degree of oppression when walking fast or climbing stairs.

The following anomalies were observed: (1) a large eventration of the left half of the diaphragm; (2) a megacolon of the portion included between the transverse and the sigmoid colon: the dilated loops occupied the major part of the upper left quadrant of the abdomen and also the lower two thirds of the left side of the chest; they displaced the mediastinum and the heart far enough to the right to make the apex beat visible outside of the right mammillary line; at the same time, they displaced the stomach to the right of the spine and downward, forcing the gastric fornix to double up so that the organ assumed the general form of a retort or a horseshoe with the concavity facing downward; (3) the loops of the small intestine occupied mainly the lower right quadrant of the abdomen: this location of the small intestine is nearly typical of malformations of the colon, especially those which involve its rotation or descent; (4) there was also dystrophic development of the transverse colon, the cecum, and the sigmoid colon (microcolon?).

The author thinks that this case should not be regarded as one of eventration of the diaphragm due to paralysis or even paresis of the organ. There was no paradoxical respiration; the respiratory movements and their amplitude were practically normal and synchronous; the left lung functioned normally, although it was smaller than the right. This explained the fact that the patient had suffered only slight disturbances, was capable of earning a living and had carried two children to term. This was a case of congenital eventration; its cause was to be found in an anomaly of the mesocolon which was probably very short: its bands, which were observed in some roentgenograms, must have impeded the descent and the rotation of the colon and favored the appearance of the partial megacolon. This concept was supported by the location of the small intestine as well as by the defective development of the cecum and of the transverse colon, if these parts really were a cecum and a transverse colon and not the last portion of the jejunum which in replacing them had acquired some of their characters. The constricted sigmoid colon seemed also to denote a difficulty in the union of the last portion of the colon with the rectal ampulla. It was evident that, in the absence of exploratory laparotomy or of an anatomical specimen, all this was mere speculation. However, be this as it may, the primary cause of the anomalies found in this patient was the same as that which had produced the megacolon, and the megacolon in turn was the secondary cause of most of the other anomalies. RICHARD KEMEL, M.D.

Posgay, I. von: Pneumatosis Cystoides Intestinalis (Pneumatosis cystoides intestini). *Wien. med. Wchnschr.*, 1941, 1: 105.

Pneumatosis cystoides intestinalis is a rare intestinal illness. The author describes 1 such case which began with cramplike pain in the region of the stomach and remained localized in the right lower abdomen. There was also persistent nausea but without vomiting, as well as constipation in the first days with erratic defecation later. Because of the suspicion of appendicitis, operation was performed. The wall of the cecum was thickened; it felt like an air cushion and exhibited on its superficial surface small thin-walled vesicles. These were also present on the omentum. Because of bandlike adhesions of the surrounding structures to the appendix the appendix was removed. Pathologicohistological study of an excised piece of tissue from the omentum and of the appendix revealed the presence of gas bubbles but otherwise no significant changes.

There are two theories as to the cause of this intestinal pneumatosis. One assumes a mechanical cause, the other an infection. Animal experiments, especially with swine, speak in favor of the mechanical genesis. The adherents to the infection theory assume that the symptom picture is produced by the action of gas-forming bacteria. The author believes that both theories fall short of an adequate explanation of the histological picture. In as much as the condition produces no characteristic symptoms, the diagnosis can usually be made certain only by operation. Obstipation is one single almost regularly observed phenomenon with accompanying dyspepsia which is mentioned. The disappearance of the liver dullness is also an important symptom. When in a case of advanced illness moveable and elastic tissue is felt in the abdomen pneumatosis cystoides intestinalis should always be considered.

With regard to treatment it is pointed out that removal of the little vesicles alone is purposeless. It is far more important to remove the primary disease, i.e., the demonstrable gastro-intestinal stenosis. The prognosis of symptomless cases is good enough to indicate that spontaneous healing can occur. Otherwise exploratory laparotomy to remove the underlying cause usually results in healing. If the pneumatosis, on the contrary, heals with an accompanying stenosis which may result in intestinal obstruction, the prognosis will be more unfavorable as a result of diminution of the prospect of operation. Allusion is made to the importance of roentgen studies before operation for the establishment of the diagnosis. (Haagen). Edward W. Gibbs, M.D.

Mayo, C. W., and Judd, E. S.: Surgical Resection in Non-Specific Ileocolitis. *J. Am. M. Ass.*, 1941, 117: 836.

The authors scrutinized the various methods of attack in 100 cases of non-specific ileocolitis in an attempt to facilitate the future choice of method.

There were 32 cases in which resection in one stage was performed. When anastomosis and resection are performed in one stage, a reasonable additional safety measure is accomplished by leaving the transverse colon out as a retrograde colonic stoma proximal to the anastomosis. This may be closed later if and when indicated by the general condition of the patient.

Sixty-four patients underwent resection in two stages. There were many factors which influenced the wait between the ileocolostomy and subsequent resection, so that the interval varied from one month to eleven years. The average interval between stages was fourteen and four-tenths months.

Only 4 patients underwent resection in multiple stages.

Of 32 patients operated on by the one-stage method, 7 died.

Of the 25 patients who were dismissed to their homes, 24 were followed up from one to five years. Thirteen of the patients are classified here as "cured" and 7 as benefited; 2 had a recurrence, 1 of whom died in the hospital, and 2 patients had died at home.

In the group of cases in which operation was performed in two stages, 57 of the 62 patients who were dismissed to their homes were followed up from one to five years. Twenty-six are classified as "cured," 19 as benefited, 9 as not showing any benefit or being worse, and 3 as having died. Two of these patients died two years after operation and 1 died nine months after operation.

The follow-up disclosed that the longer the patient survived after resection, whether it had been performed in one or more stages, the better the subjective and objective results appeared to be.

Dragstedt, L., Dack, G. M., and Kirsner, J. B.: Chronic Ulcerative Colitis. *Ann. Surg.*, 1941, 114: 653.

The results of an eight-year study of chronic ulcerative colitis have persuaded the authors that the bacterium necrophorum, together with some unknown factors, plays an etiological role in the disease. Bacterial studies were made from anaerobic cultures taken from 12 patients with chronic ulcerative colitis in whom the fecal current has been diverted by end-colostomy. With the diversion of the fecal current, aerobic organisms diminished steadily in number and after five or six weeks the flora became almost entirely composed of non-sporulating anaerobes.

Stained preparations of bacterium necrophorum reveal a gram-negative pleomorphic rod, with occasional filamentous forms and irregular staining, but with no true branching and no spores. It grows only in a strictly anaerobic environment and is easily killed by exposure to oxygen. The organism has been recovered in pure culture from mesenteric lymph nodes of the ascending colon in one patient, and from a thrombus in the portal vein at the hilum of the liver in another patient who died of ulcerative colitis. It is easily recovered during periods of acute exacerbation, when blood and pus are present in the colon discharge, but is not found, or only with difficulty, during periods of quiescence. In 70 per cent of 298 patients with all stages of the disease examined in

the past eight years, a positive culture of bacterium necrophorum has been obtained.

Perhaps the best evidence implicating this organism as an etiological agent in ulcerative colitis has been the discovery of specific antibodies in the blood of patients with the disease but not in normal individuals. Both complement-fixing antibodies and agglutinins have been demonstrated. Strains of bacterium necrophorum recovered from cases of ulcerative colitis are pathogenic for rabbits, producing in them chronic abscesses on subcutaneous injection.

HAROLD LAUFMAN, M.D.

Jungbluth, J.: Appendicitis and Its Treatment (Ueber die Appendicitis und ihre Behandlung). *Deutsche Ztschr. f. Chir.*, 1941, 254: 289.

The author first presents a historical review of appendicitis. The first appendectomy was performed in Germany in 1889 by Schueller. Then with a large series of cases the indications for operation were firmly established. However, even though the patients are brought to the surgeon as soon as possible nowadays, still more than 5,000 persons die with appendicitis annually.

The symptom picture of appendicitis has been divided into several forms. Sprengel distinguishes two groups. In the first group he includes simple and destructive appendicitis, in the second the various forms of peritonitis. The author proposes a division into appendicitis with and without involvement of the peritoneum.

The mortality rates from hitherto existing publications are given. In earlier times the physician hesitated for a long time to relinquish appendicitis to the surgeon immediately. The question of the proper time to interfere was for a long time disputed. The greatest unity is still in favor of early operation. When the patients do not come during the first part of their illness, the surgeons are not entirely in accord. The various viewpoints in Germany and other countries are given. In serum treatment there has been no essential change. In the treatment of encapsulated inflammatory processes the conservative method has been used for the most part.

The number of white blood cells gives no reliable information which would help to form a conclusion. An increase is an accompanying symptom of appendicitis. The number merely gives an indication of an abscess when the increase is large, while a decrease may give an indication of appendical inflammation frequently simulating typhoid illness. In the presence of peritonitis determination of the alkali reserve aids in the estimation of the prognosis.

The author then takes up the treatment of peritonitis resulting from perforation of the appendix. He has previously reported more than 200 cases in 1935 in which he advised against operation. The favorable experience gained in adoption of this method induced him to delay treatment more often. The patients are not operated upon until they are absolutely afebrile. The treatment consists of the administration of morphine and the restriction of fluids as long as nausea is present. In the first twenty-four hours only fluids should be given. Involvement of the peritoneum is assumed with elevation of the temperature, reflex rigidity of the abdominal muscles, vomiting, and increase in the pulse rate. The more time allowed for the infection to subside the better the results. In the course of time this waiting treatment shows no threatening symptoms. The value of early operation lies in the prevention of perforation and for that reason, according to the author's view, early operation should be striven for.

If involvement of the peritoneum or even a perforation is assumed the following course should be taken. Early cases with beginning involvement of the peritoneum can still be operated upon, but patients in whom there is an extensive involvement of the peritoneum or even a perforation are not to be operated upon until the inflammation and fever has completely subsided.

(RATHCKE). EDWARD W. GIBBS, M.D.

Hollström, E.: Myxoglobulosis Appendicis (Myxoglobulosis appendicis). *Acta chirurg. Scand.*, 1941, 85: 347.

Myxoglobulosis appendicis is an unusual, degenerative species of mucocele appendicis, which is filled with mucous balls resembling cooked sago kernels or frog or fish eggs, and its communication with the cecum is obliterated. In American literature this is also known as "fish-egg-mucocele." The author found only 36 reports of myxoglobulosis appendicis in the literature. Of the many theories covering its etiology, none is accepted as positive. A reasonable theory is given as follows:

1. A phlegmon in the proximal part of the appendix causes the obliteration of its connection with the cecum.

2. The contractions of its hypertrophied musculature against the obliterated cecal opening produces a collection of mucus in the appendix.

3. This is followed by an enlarged appendiceal cavity with indentations of its walls.

4. This abnormal physiological activity, plus the admixture of connective tissue, shapes the mass into forms of balls.

5. The coagulation of the balls is prevented by the thin fluid expressed from them.

The number of these characteristic balls found varied from 50 (Sturm) to 1,500 (Poindecker). Their sizes are given as varying from the size of a needle point to 1 cm. The masses vary from a slimy frog-spawn appearance, to that of a group of tough, gelatinous, opaque or transparent, light grayish, irregularly shaped, round or slightly oblong bodies, usually the size of a dried pea.

The author's case was that of a man sixty years old, who had never been sick excepting for a pleuritis in 1918. On April 4, 1940, he experienced lancinating pains in the stomach radiating toward the sternum. Emesis with chills occurred at 9 a.m., following breakfast. Nausea continued, but no more emesis. At 3 p.m., he walked about 2 km. to the Upsala

University Clinic. His condition was not alarming: his temperature was 37.7°C., his pulse 72, and his blood pressure 165/110. There were no symptoms of any other organic involvement. McBurney's point was sensitive, but all other physical examinations were negative. Leucocytes amounted to 12,200 with 11,000 polynuclears. Three hours later the leucocytes had increased to 15,700 and the polynuclears to 14,100. These findings, together with increased pains, were the deciding factors for immediate operation. Incision for appendectomy disclosed a very long and thick appendix with its distal end impinging itself in the incisional opening. No other abdominal pathology was found.

The appendix was 10 cm. long, rigid, and as thick as a finger. Incision of the serosa was followed by the forcible jumping out of a diverticula-like mass in consequence of the very high intra-appendicular pressure. Opening of the appendix yielded a mass of gelatinous balls which, as regards size, form, and transparency, resembled cooked sago kernels. In addition, there was free mucous. The mucous membrane showed no signs of inflammatory changes. The base of the appendix revealed a fibrous obliteration.

The pathologico-anatomical diagnosis was chronic appendicitis with myxoglobulosis.

Seven of the 36 cases of myxoglobulosis described in the literature gave rise to pseudomyxoma peritonei; and in 1 case the ball-filled appendix, with its apex adhering to the cecum, had encircled a coil of the small intestine, thereby giving rise to ileus.

In some patients, symptoms of appendicitis were present, and in others the myxoglobulosis was discovered only at autopsies.

MATHIAS J. SEIFERT, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Ivy, A. C.: Applied Physiology of Bile Secretion and Bile-Salt Therapy. *J. Am. M. Ass.*, 1941, 117: 1151.

In this short résumé of applied physiology of bile secretion and bile-salt therapy Ivy has sought to answer the question of the rationale of the therapeutic use of bile salts in disease of the biliary tract. Bile-salt production is normally stimulated by the ingestion of protein and not by that of fat or carbohydrates. There is no relationship between bile-salt output and caloric intake in dogs with a biliary fistula. In cholecystectomized animals frequent feedings given at six-hour intervals cause a more constant rate of bile flow than feedings which are given only three times daily. This statement is not true necessarily for animals with intact gall bladders.

The rate of production of bile salts balances the rate of destruction. About 10 per cent of the bile salt is lost during its enterohepatic circuit. This deficiency is made up from protein metabolism and a plateau level of bile-salt production is finally reached. The addition of excess bile salt to the intestinal tract causes catharsis (sluice mechanism) and the bile salts are passed into the colon and feces. In the cholecystectomized patient the hemostatic level or saturation point of bile salts in the enterohepatic system is best maintained by an adequate protein diet.

Dehydrocholic acid or oxidized unconjugated cholic acid is definitely hydrocholeric. The other bile salts vary considerably in their choleric ability. Dehydrocholic acid and oxidized unconjugated bile salts also definitely and uniformly increase the blood flow through the hepatic artery. In the presence of liver damage severe enough to suppress the formation of cholic acid, the administration of bile salts does not cause choleresis and the added cholic acid is not eliminated in the bile salts. Experimentally the author was unable to prove that the administration of bile salts in the presence of obstructive jaundice is definitely harmful. After temporary obstruction of the common bile duct with the production of jaundice there is no evidence to show that bile pigment will disappear from the blood stream more quickly after the obstruction is released—and bile salts are administered.

The presence of choleresis obviously flushes the bile ducts but does not flush the gall bladder. The gall bladder is best flushed by frequent evacuation which facilitates the removal of sediment. Frequent high fat feedings cause frequent evacuations of the gall bladder but the addition of bile salts causes no additional effects. HOWARD A. LINDBERG, M.D.

Meyer, K. A., Popper, H., and Ragins, A. B.: Histological Distribution of Vitamin A in Biopsy Specimens of the Liver. *Arch. Surg.*, 1941, 43: 376.

The fluorescence microscope was used to visualize Vitamin A in specimens of human livers obtained at operation. Previous studies in this field were made on the livers of animals and on autopsy specimens. This study was made to investigate the significance of objections to previous studies on human autopsy specimens, namely, that ante-mortem and post-mortem changes might affect the distribution of Vitamin A in the livers. The influence of the known pre-operative nutritional state on Vitamin A content in the liver, and the influence of hepatic function on the distribution of the vitamin were also studied.

Specimens of the liver were taken in 29 cases in which the liver was exposed at operation. The patients selected for study received different types of diets, and all of them consumed a known diet for at least eight days prior to operation. Part of the material was fixed in formaldehyde solution and frozen sections were cut within thirty minutes; the other portion was prepared for routine histological examination.

The distribution of Vitamin A in this study was similar to that found in the study of autopsy material. In 2 patients who had received a large dose of Vitamin A concentrate the day prior to operation, the fluorescence was strikingly increased. The fluorescence was evenly distributed between the liver and Kupffer cells. Otherwise, except for prolonged

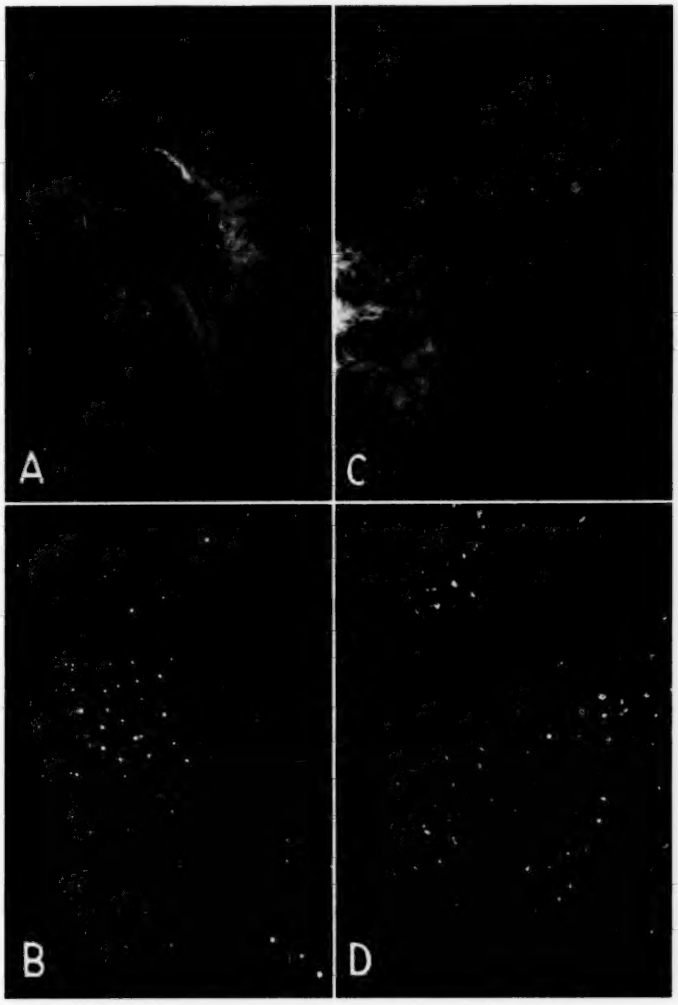

Fig. 1. Fluorescence photomicrographs: *A*, perilobular cirrhosis. The little Vitamin A fluorescence is imparted chiefly by the Kupffer cells. (The connective tissue of the proliferated periportal field gives a strong, non-fading blue fluorescence which appears white in the photomicrograph.) *B*, toxic edema of the liver. The Kupffer cells are rich in Vitamin A fluorescence, while the liver cells are free of the Vitamin A. *C*, jaundice. The area around the periportal field is free of Vitamin A. In the intermediary zone the liver cells are free of Vitamin A fluorescence, while the Kupffer cells contain a normal amount of Vitamin A. *D*, diabetes mellitus. The Kupffer cells are rich in Vitamin A fluorescence. The liver cells show small amounts, especially in lipofuscin.

starvation, no striking influence of the nutritional state on the Vitamin A fluorescence of the liver was observed. No influence of age or of the type of anesthesia on the distribution of Vitamin A was apparent.

The results suggest that the functional state of the liver cells determines the Vitamin A content of the liver. In all cases in which pathological change of the parenchyma of the liver was present, the Vita-

min A fluorescence was markedly reduced. Pathological changes in the periportal fields did not affect the distribution strikingly. A block in the exchange of Vitamin A between the Kupffer and the liver cells was found in cases of damage of the liver cells, jaundice, toxic edema, and diabetes mellitus. The fluorescence microscopic examination of the liver for Vitamin A may help in the morphological demonstration of damage of the liver cells.

JOHN L. LINDQUIST, M.D.

Geissendoerffer, H.: Is the Extensive Use of External Choledochoduodenostomy Desirable? (Ist eine ausgedehnte Anwendung der Choledochoduodenostomia externa wuenschenswert?). *Deutsche Ztschr. f. Chir.*, 1941, 254: 379.

There is no unanimity of opinion, as yet, as to the possible applications of external choledochoduodenostomy. In general, it is used when the gall bladder is so damaged that it cannot be utilized for anastomosis and must be removed, or when it has already been extirpated. Hesitancy must prevail whenever there is great tension, or when the tissues of the bile tracts are friable and degenerated. The reason for the operation is an obstruction to the bile flow, either within or outside of the bile ducts. In the former type low-lying gall stones or calculi incarcerated in the papilla of Vater play an important role, as well as true tumors of the papilla, cicatricial stenoses, and cysts of the bile ducts. Biliary obstruction outside of the bile ducts is caused by diseases of the head of the pancreas, true neoplasms, or recurring inflammatory swellings.

In recent times, this operation has been recommended instead of drainage of the common duct. It is thought that further stone formation is more surely prevented, and there is no loss of bile. Furthermore, the procedure is easy. Most surgeons, however, do not accept these generalizations. Nevertheless, the chief objection raised, that of ascending infection, is rarely justified. The author believes there is no reason to distort the bile flow as much as this type of anastomosis does. We do not know whether the anastomosis does or does not become narrowed, or whether it eventually becomes obstructed. Latent jaundice and subsequent liver damage are dangerous possibilities.

Among 750 operations on the bile tract done at the Frankfurt Clinic, this procedure was used 22 times (2.8 per cent). Thirteen of the cases could be followed up; the remainder were almost all malignant tumors, which would be lost anyway. In 5 of the 13 cases there were severe liver injuries, and these were independent of whether the anastomosis was demonstrably functioning in the roentgenogram. The author therefore concludes that external choledochoduodenostomy is a much more extensive and dangerous operation than is simple drainage of the bile ducts, and its use should be limited to those cases in which the simpler measures are no longer capable of restoring continuity of the bile flow.

(VOGELER). LEO M. ZIMMERMAN, M.D.

Brunschwig, A., and Clark, D. E.: Carcinoma of the Intrapancreatic Portion of the Common Bile Duct. *Surgery*, 1941, 10: 553.

In both of the cases reported by the authors the clinical diagnosis of cancer of the head of the pancreas or ampulla was made and as a result of palpation at laparotomy it was thought the former diagnosis was confirmed. The operative procedures for excision of such neoplasms were followed. The true situation was discovered only upon study of the surgical specimens in the laboratory. In one of the patients the disease was extensive; in the second case, in spite of the long history, the process was still localized. Because of the rarity of small localized malignant tumors arising from the intrapancreatic portion of the common duct this condition was not even considered at the time of operation.

The clinical picture of carcinoma of the lower segment of the common bile duct does not differ sufficiently from that afforded by cancer of the ampulla, confluence of the extrahepatic bile and cystic ducts, cancer of the cystic duct or gall bladder, or cancer of the ampulla of Vater, or of the head of the pancreas to permit of specific pre-operative diagnosis. However, such a possibility should be considered when on palpation small tumor masses are felt in the head of the pancreas in the course of the common duct.

Attempts at excision are justifiable in the absence of evidence of metastases since, as a group, they are not rapidly growing tumors and metastasize relatively late.

The procedure indicated is pancreatoduodenectomy when the pancreas is involved (as for carcinoma of the head of the pancreas); however, a more conservative segmental resection may be possible when the tumors are still small. JOSEPH K. NARAT, M.D.

MISCELLANEOUS

Hultén, O.: Abdominal Pain and Dorsal Splanchnicus Anesthesia (Ueber Bauchschmerz und dorsale Splanchnikusanaesthesie). *Acta chirurg. Scand.*, 1941, 85: 281.

Hultén summarizes what we know of pain perception arising from the abdominal organs, and states some of his own beliefs. He is of the opinion that the cessation of pain localized in the abdominal wall and arising from intra-abdominal disturbances after infiltration of the wall is due to the cessation of muscular spasm in this area, rather than being an expression of a interruption of function of the spinal ganglion cells, as was believed by Lemaire. Pain in the mesentery is chiefly linked to the vessels there. The vagus and phrenic nerves do not seem to participate in pain conduction from the abdomen; probably the splanchnic nerve only transmits pain from there.

For surgical anesthesia in the abdominal space interruption of the spinal nerves of the abdominal wall and of both splanchnic nerves is necessary. This is accomplished most simply by spinal anesthesia up to D5. The disadvantage of this anesthesia, the lowering of the blood pressure, is not present when splanchnic anesthesia combined with abdominal wall

infiltration is used. This, however, does not provide as good a relaxation of the abdominal wall as does spinal anesthesia. Splanchnic anesthesia can be given to very fat people easily.

The method of Braun—infiltration of the splanchnic nerve area from the front after opening of the abdomen—is not well suited for operations on the biliary passages, as it requires a midline incision. Kappis' method of splanchnic anesthesia from behind is Hultén's method of choice for such operations if general or spinal anesthesia appear undesirable in a given case.

He injects 0.5 per cent procaine solution in wheals 7 cm. lateral from the midline, distal from the last rib, through thin needles of from 12 to 15 cm. in length, which are inserted at an angle of 30 degrees toward the midsagittal plane, and sometimes a little cephalad. The needle hits the lateral aspect of the vertebral body, and 5 c.cm. of the procaine solution are injected at that point. The same is done on the other side. In the meantime, the site of the first needle has been well anesthetized, and the needle is advanced until it leaves the lateral aspect of the vertebral body. As soon as this is felt, 60 c.cm. of the anesthetic are injected on the right and 40 c.cm. on the left side. Cadaver studies have shown that the needle almost never contacts the kidney if it is advanced as has been described. The injected fluid spreads from D8 to L_3, chiefly along the large vessels in the mesenteric root, and after the injection, one must wait at least half an hour until the height of anesthesia is obtained. During this time the abdominal wall is infiltrated with the same solution, with special attention to the parietal peritoneum which may have to be reinfiltrated from the incision before it is closed. The only pain reported with this procedure occurs upon suture of the external oblique muscle; it probably originates in the costals attachments which are beyond the field of anesthesia.

Usually Hultén uses from 250 to 300 c.cm. of 0.5 per cent procaine and from 12 to 15 drops of epinephrine, 1:1000. Intravascular injection, of course, must be avoided painstakingly.

If the cases in which an unfit injection fluid was used by mistake are omitted, the literature shows the mortality of this anesthesia to be about 1 in 10,000.

The anesthesia thus obtained in general is excellent, but it demands operating with extreme care, as all rough and sudden movements are felt and incite tension of the abdominal wall. The anesthesia is not recommended for occasional use, as practice is necessary, both for the anesthetist and the operating surgeon, the first to become familiar with its administration, and the latter to become accustomed to performing the operation with proper finesse.

HEINRICH LAMM, M.D.

GYNECOLOGY

UTERUS

Solomons, E.: A Survey of the Results of Repair and Amputation of the Cervix. *J. Obst. & Gynaec. Brit. Emp.*, 1941, 48: 461.

Solomons, of Dublin, presents a survey of 104 cervical operations with an evaluation of results based on his personal findings in the follow-up examination of each case. The procedures employed were Emmet's trachelorrhaphy, Schroeder's amputation, and circular amputation. The last includes Sturmdorf's method, which was used in a certain number of cases. Of the 104 cases, 94 showed "much improvement from operation"; 70 were free of discharge. Backache was the commonest residual symptom.

The use of trachelorrhaphy in the child-bearing period is stressed and especially in relation to fertility. Twenty-three of a possible 30 patients became pregnant following trachelorrhaphy. Seventy-two of the entire series revealed completely healed cervices, and in 1 a bad result was reported. No cervical carcinomas were found in this postoperative group; sepsis was absent; and only 4 patients developed a secondary hemorrhage. WILLARD G. FRENCH, M.D.

Numers, C. von: The Pathogenesis of Endometriosis Externa with Observations on the Behavior of the Epithelial Cells of the Heterotopic Mucous Membrane (Ein Beitrag zur Frage der Pathogenese der Endometriosis Externa nebst Bemerkungen ueber das Verhalten der Epithelzellen der heterotopen Schleimhaut). *Acta obst. et gynec. Scand.*, 1941, 21: 151.

Our present experience denies the existence of a mechanism of development common to all cases of endometriosis externa. According to the author, the possibility of a retrograde transport of free particles of uterine mucosa, desquamated during menstruation, and their subsequent peritoneal implantation is clear to most investigators, although Sampson's well known theory of implantation as such does not have universal acceptance. The chief objection is concerned with the functional potency of the particles of mucosa of the uterus which are cast off during menstruation. This desquamated tissue has undergone high retrograde changes and has no demonstrable capability of cell increase and proliferation.

Many authors attribute the passage of endometrial particles into and through the tubes to mechanical factors, e.g., operative procedures, salpingography, or strong bimanual compression. Patients with endometriosis of the abdominal cavity have, in a considerable percentage of cases, mucosa of the corpus type in the isthmus portion of the tubes. By proliferation of these cells obliteration of the lumen of the tubes often occurs, with resultant sterility.

A remarkably high proportion of patients with endometriosis externa present evidence of inferiority of the genital apparatus both somatically and functionally. Thus, before the clinical signs of endometriosis are manifest, sterility, dysmenorrhea, genital hypoplasia, myoma, delayed appearance of the menses, and disturbed ovarian function are observed.

In this type of women is found a functional anomaly which has recently been the subject of special investigation—the "non-ovulatory bleedings" of American writers, or pseudomenstruation. This occurs usually at regular periods, a cyclic hemorrhage from a uterine mucosa which in the absence of ovulation has not passed through the transformation stage but upon the occurrence of the hemorrhage proceeds to the stage of proliferation. As we know, this type of cyclic hemorrhage was first observed in apes, but gradually evidence accumulated that it occurred also in human beings. According to Emil Novak, "anovulatory mechanism is by no means rare."

Such cyclic hemorrhage without ovulation appears to be particularly common in the very conditions which we find in the histories of patients with endometriosis. The author finds a possible causal relation between pseudomenstruation and endometriosis in the assumption that the particles of endometrium, the implantation of which in the abdominal cavity might result in endometriosis, did not have their origin in menstruating uterine mucosa but precisely in these "anovulatory bleedings." The greatest objection to Sampson's theory, that the particles of tissue thrown off from the menstruating mucosa would not be viable, is thus eliminated since the mucosa under consideration is in the stage of proliferation and capable of implantation.

As to the "latent period" of endometriosis, the time between an assumed implantation and the appearance of symptoms, little is known. The typical clinical symptoms depend chiefly upon the hemorrhages from the heterotopic tissues in association with the menstruation. Evidently this period may be quite variable. Cases are recorded in which no diagnostic signs of endometriosis except sterility were present, but at laparotomy a plentiful implantation of endometrial foci was found upon the pelvic peritoneum. An absence of these growths was noted in the abdominal cavity. Apparently in man, as in the apes, pseudomenstruation may alternate with normal menstruation.

It is difficult to draw conclusions from the morphology of heterotopic mucosa as to the ovarial function. However, in most cases the epithelium reacts to the corpus luteum hormone only if the glandular ducts are enveloped in a sufficiently dense covering of specific endometrial stroma.

The assumption that the endometrial heterotopic implants occur in connection with non-ovulatory bleeding cannot be substantiated. The purpose of the present study has been only to call attention to this possibility and to show that it is not directly contradicted by the facts. J. M. SALMON, M.D.

MISCELLANEOUS

Westman, A.: The Hormonal Treatment of the Amenorrheas (Die hormonal Behandlung der Amenorrhoen). *Acta obst. et gynec. Scand.*, 1941, 21: 105.

The author gives the following prerequisites for the successful treatment of endocrine insufficiency:

1. The possibility of localization of the pathological process in a definite glandular organ or system.
2. The presence of functional tests by which the nature and severity of the disturbance may be determined.
3. Access to effective hormone preparations.

These conditions are met in certain forms of illness associated with insufficiency of the thyroid, also in changes of the parathyroids and the pancreas, Here the clinical picture points to the cause of the malady, the diagnosis is confirmed by appropriate tests, and effective glandular preparations are available. However, in diseases of the female generative apparatus characterized by insufficiency, these prerequisites are not present although the symptoms may be very definite. The immediate cause is doubtless to be sought in insufficient ovarian function but the basic cause is indeterminable.

The author presents the various factors which may be involved in the development of amenorrhea. These include disturbance of the ovarian function because of absence of follicles (vegetative), inferiority of the ovarian parenchyma (congenital or acquired), or diminished or absent production of the gonadotropic hormone of the anterior lobe of the hypophysis. The latter condition may be suspected in the presence of acromegaly and Simmond's disease.

Evidently disturbance of the female sexual functions may develop as a result of injury, abnormality, or disease of one or more of the members of the system formed by the diencephalon, the hypophysis, the ovary, and the uterus. The author emphasizes the necessity of careful and thorough preliminary physical examination by a competent internist in every case of amenorrhea. The endometrial examination frequently yields valuable information, particularly if repeated at appropriate intervals. This may be done with the aid of a suction curette with little inconvenience to the patient. Enormous follicle growth, or absent or possibly prolonged corpus-luteum function are clearly shown, as a rule, by the structure of the mucosa. However, the common picture in anemia is atrophy, and it is impossible to state whether the primary cause is to be sought in a defective anterior lobe, deficient ovarial function, or incapability of the endometrium to react.

Efforts to obtain definite information as to the hormonal status of the patient by determination of the follicle and gonadotropic hormones of the blood or urine and by estimation of the pregnandiol secretion in the urine have been unsatisfactory. Ovarian-hormone titrations in amenorrhea are of value, in certain cases, chiefly to obtain a basis for prognosis. Further investigation is necessary before one can decide whether an amenorrhea is of hypophyseal or ovarian origin.

A more accurate knowledge of the physiological action of the ovarian hormones and the acceptance of the view that many cases of amenorrhea were attributable to reduced endocrine activity of the ovaries led to the treatment of these conditions by the administration of the available specific hormone preparations. This seemed rational and justified by experience in the treatment of insufficiencies of other endocrine glands, particularly those of the thyroid. However, the results of ovarian-hormone therapy in many instances were unsatisfactory and other methods were sought. The most promising of these was the administration of gonadotropic hormones. Examination of the endometrium before and after treatment with these hormones showed that atrophic uterine mucosa could be brought to the stage of secretion and that the estron and pregnandiol secretion of the amenorrheic patient increased.

Implantation of animal hypophyses was first employed by Ehrhardt in 1928 in conditions of ovarian insufficiency. He believed that by this means he effected a pluriglandular stimulation which maintained the functional activity not only of the gonadotropic but also of the other glandulotropic hormones of the anterior lobe of the hypophysis.

The author employed hypophyseal implantation in 7 cases of primary amenorrhea with lasting result in 1 case. He first presents a survey of the most frequent causes of amenorrhea and refers to the difficulty of their recognition in individual cases.

The specific methods employed in amenorrhea have been, above all, treatment with ovarian hormones, injections of gonadotropic hormones, and hypophyseal implantations. The results varied greatly but under certain circumstances a favorable and lasting effect could be obtained. Estron promotes the growth function of the uterus and possibly has a similar effect upon the hypophysis. In certain cases it is possible by the administration of gonadotropic hormones to cause a growth process of the ovaries which may be demonstrated anatomically.

The author reports 126 cases of amenorrhea treated with hormones. In 21 cases the amenorrhea was primary; in 105, secondary. In all cases the patients had received a careful general examination, the basal metabolism had been determined, and evidences of ovarian deficiency and genital atrophy had been recorded. The urinary prolan and folliculin values were frequently determined but only once or twice as a matter of routine. The cases have been grouped according to the results of treatment, the duration of the amenorrhea, and the methods of treatment.

Nine of 21 cases of primary amenorrhea were treated with estron (ovex leo); in 2 of these a lasting result was obtained. Five cases were treated with gonadotropic hormone combined with serum and chorion hormone (antex leo plus physex leo) without result. Seven cases were given a hypophyseal implantation with 1 lasting result. Sixty-four cases of

secondary amenorrhea were treated with estron and in 30 of these there were lasting results. Since in 51 of these the duration of the amenorrhea had been only from one-half year to three years one must consider the possibility of spontaneous and independent restoration of the menstrual function.

Twenty-four secondary cases were treated with gonadotropic hormone. Favorable results were obtained in 11, but since, in 18 cases the duration was from one-half year to three years, spontaneous improvement must be considered in some of these cases also. However, in several of these, endometrial examination showed that the previously atrophic mucosa frequently shows a proliferation or secretion phase, respectively, after treatment with gonadotropic hormones, and thus attests that the ovaries were affected by the treatment. Seventeen cases of secondary amenorrhea were given an implantation of calf hypophysis with lasting results in 4 cases.

The investigations show that in certain cases a lasting result may be obtained with hormone treatment. In primary amenorrhea this is exceptional. In secondary amenorrhea the time factor is important. The shorter the duration, the better are the prospects of success. After three years, recoveries are relatively few.

The author advises estron therapy first as this is least expensive. In the event of failure, a combination of serum and chorion gonadotropin may be tried. Hypophyseal implantation may be considered especially if symptoms of general hypophyseal disturbances are present.

In amenorrhea of short duration, from one-half year to three years, it is questionable whether treatment is superfluous since menstruation may return spontaneously. This cannot be predicted, but late treatment gives unsatisfactory results. Therefore therapy seems indicated. Its greatest value is that it increases the possibility of motherhood.

J. M. Salmon, M.D.

Pallos, K. von, and Treite, P.: A Contribution to the Pathology of Functional Uterine Bleeding of the Climacteric and Postclimacteric Ages (Zur Pathologie der funktionellen Gebaermutterblutungen des klimakterischen und postklimakterischen Alters). *Ztschr. f. Geburtsh u. Gynaek.*, 1941, 122: 28.

Present day knowledge concerning the cyclic endometrial changes of the uterus and their dependence upon the rhythmic phenomena in the ovary has brought about the division of the acyclic gynecological hemorrhages into two etiological groups. Today it is possible to divide strictly the hemorrhages caused by hormonal disturbances from those resulting from other causes. The latter class may be caused by inflammatory processes in the uterus, adnexa, and parametrium; by abortions; and by changes in the position of the uterus. The hemorrhages of hormonal etiology are directly dependent upon the disturbed secretory function of the ovary and for this reason they are designated as functional uterine hemorrhages. The latter are brought about by disturbances in the quantitative hormonal production during the follicular-hormone or corpus luteum phases, or by irregularities in the chronological occurrence of these, and result in extremely variable pathological pictures in the endometrium. In order to present a review of the histological pictures of the uterine mucosa, the authors have gathered together a material of 2,000 cases from the climacteric and postclimacteric ages, in which, on the basis of the gynecological and histological findings, a disturbance in the internal secretory activity of the ovaries was to be assumed. The discussion of this material, from the morphological and etiological viewpoint, was carried out in the light of the opinions outlined by R. Meyer in his work and personal expressions during his daily work at the microscope.

The individual pathological mucosal pictures were correlated with the dual hormonal function of the ovary in the following manner:

The follicular-hormone phase. 1. The regeneration stage of the endometrium; (a) normal regeneration of the endometrium, (b) stasis in the regenerating endometrium, (c) insufficient regeneration of the endometrium, and (d) irregular regeneration of the endometrium. 2. Proliferation stage of the endometrium: (a) normal proliferation of the endometrium, (b) stasis in the proliferating endometrium, (c) insufficient proliferation in the endometrium, (d) irregular proliferation of the endometrium, and (e) hyperplasia of the endometrium.

The corpus-luteum-hormone phase. 1. The functioning stage of the endometrium: (a) normal function of the endometrium, (b) stasis in the functioning endometrium, (c) irregular function of the endometrium, (1) morphological irregularities, (2) functional irregularities, (d) increased function of the endometrium, and (e) functional hypertrophy of the endometrium. 2. The stage of endometrial disruption: (a) the extrusion of the endometrium following function, and (b) irregular extrusion of the endometrium.

The rest period of the endometrium. 1. Functionless endometrium. 2. Atrophic endometrium.

The histological pictures of the individual sections as well as the genetic relationship between the individual mucosal pictures and the functional disturbances in the ovaries are thoroughly discussed at the appropriate places. Especially to be emphasized are those sections which deal with the question of mucosal hyperplasia, increased function, and functional hyperplasia. As to the hyperplasia of the endometrium those mucosal pictures in which the glands occasionally permit the recognition of a secreting phase are especially considered. These glands show the typical sawlike form and also irregular forms and contain secretion in the lumen, and the gland cells permit the recognition of a secretion space toward the lumen. Even the nature of the glycogen staining *per se* makes it possible to determine unconditionally whether we are dealing with a functioning phase. By means of this testing

method one frequently obtains surprising pictures, in that frequently in irregular and even in cystically distended cells the presence of glycogen can be shown, whereas, on the other hand, in typically formed glands no glycogen can be demonstrated. One speaks of a "hyperplasia with occasional function" only if the glycogen test is positive at the questionable places, regardless of whether the gland permits the recognition of the typical picture of the secretory phase or not. These pictures are offered as a proof of the fact that hyperplastic mucosa may pass over into the stage of a functioning endometrium without being preceded by an extrusion of the mucosa. Not only follicular cysts but also the follicular-hormone-forming tumors of the ovary play an etiological role in this hyperplasia. While these tumors are of only slight etiological significance in the sexually ripe, in the climacteric age they come more frequently into consideration as the cause of mucosal hyperplasia in the postclimacteric period. Attention is called to the significance of a two and six year limit in the postclimacteric age.

On the basis of individual cases it is shown that an endometrial hyperplasia genetically related with a hormone-forming ovarian tumor (granulosa-cell or theca-cell tumor) can be the cause of uterine bleeding of six or more years after the cessation of menstruation. A hyperplasia found during this period is an indication for operative intercession or for radiation therapy quite independent of whether the tumor is palpable or not. The authors speak of an increased function of the endometrium only if the mucosa presents a remarkably increased state of secretion. Whereas a slightly increased corpus-luteum-hormone production during the chronologically normally occurring cycle suffices to explain the development of an increased state of function, the etiological phenomena which lead to the mucosal picture of functional hypertrophy, as described by R. Meyer, are as yet not clearly defined. The microscopic picture of the mucosa in such cases is characterized by an increased state of function of the glands associated with an irregularity in the morphological glandular formation of decidual and decidual-like stroma cells, so that difficulties in differential diagnosis between a functional hypertrophy of the endometrium and the decidua of pregnancy may arise. In cases of this type a pregnancy test may become necessary in order to confirm the diagnosis. The prolonged activity of the corpus luteum persistens is held responsible for the occurrence of such cases. It is further to be assumed that in addition to the persisting corpus flavum, theca-leutin cysts also have an etiological significance in the development of this functional hypertrophy. Because of the recognized dependence of ovarian function upon the anterior lobe of the hypophysis it may be assumed that the pathologically intensified and prolonged corpus-luteum phase is brought about by disturbed function of the anterior hypophyseal lobe.

Further details may be gathered by perusal of the original article. This article includes 31 illustrations and 6 tables.

(VON PALLOS). HARRY A. SALZMANN, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Westberg, V.: Histidine in the Urine; A Method for Rapidly Establishing the Existence of Pregnancy—1,000 Cases (Histidinurie—Schnellmethode zur Graviditaetsbestimmung—Ca. 1000 intersuchte Faelle). *Acta obst. et gynec. Scand.*, 1941, 21: 180.

The author states briefly the chemical properties of histidine and explains the various reagents used for demonstrating its presence in the urine. The Regine Kapeller-Adler method was employed in this series of investigations as it takes only fifteen or twenty minutes to do the test, and its cost is low, about 15 cents. Chloroform as a preservative of histidine is satisfactory; it was preferred as the specimen of urine can be stored safely at room temperature for from eleven to fourteen days and sometimes even longer. The diagnostic reliability of the test is 91.55 per cent. However, in the presence of gestational toxicosis it is not at all reliable. The more severe the toxicity, the more unreliable is the histidine test.

Urine tests were made on 1,023 patients. Among these there were 680 intra-uterine and 11 extra-uterine pregnancies, 61 abortions, and 238 non-pregnant women; the ages of the women ranged from fourteen to eighty-one years. In addition, histidine tests were made of the urine of 19 men with pulmonary tuberculosis and of 3 men with Cushing's syndrome—all with negative results. Serial examinations during the puerperium were made in 14 cases. In the entire group 6.34 per cent of the histidine reactions were negative in the urine of healthy pregnant women; but only 3.26 per cent of the tests were negative when they were made during the first three months of pregnancy. All the pregnancies diagnosed with x-rays yielded positive reactions. The urine of the non-pregnant women and of the men contained histidine in 1.55 per cent of the cases. This amino-acid is secreted very early in pregnancy; in 7 cases the reaction was positive before the next menstruation was due.

During the puerperium, in case of normal delivery, the histidine secretion rapidly decreases; this appears to be true also in the cases of induced abortion.

In 5 of the 14 cases the histidine reaction was absent twenty-four hours after delivery.

The histidine excretion gradually increases as the gestation progresses and reaches its maximal output immediately preceding delivery.

In 20 eclamptic patients the histidine reactions were negative. This may be coincidental, but the author believes it more reasonable to assume that the gestational toxicosis was the etiological factor.

In the Obstetric Hospital of Gotenburg the Kapeller-Adler color test is made first, and only in doubtful cases is resort made to the Friedmann-Schneider or Zondek-Aschheim biological reactions.

The author predicts an increase in the number of histidine tests made in the future.

Compared with the 171 mice and rabbit tests, the histidine reaction apparently holds its own.

MATHIAS J. SEIFERT, M.D.

Mendelson, C. L., and Pardee, H. E. B.: Congenital Heart Disease During Pregnancy. *Am. J. M. Sc.*, 1941, 202: 392.

Congenital heart disease constitutes between 1 and 2 per cent of all organic heart disease so that it is a rare finding in pregnant women. Since 1932 at the New York Lying-In Hospital there have been 1,089 recognized cases of organic heart disease in approximately 31,000 obstetrical patients. Of these 1,089 cases, 20 (1.89 per cent) have been diagnosed as congenital heart disease. There were 8 cases diagnosed as pulmonic stenosis, 4 as interventricular septal defect, 3 as coarctation of the aorta, 2 as patent ductus arteriosus, and 1 as patent foramen ovale; 2 cases were not specifically diagnosed as a congenital anomaly. All but 4 of the patients were placed in Classes 1 and 2, according to the scheme of cardiac functional capacity of the New York Heart Association. There were no deaths in this series of cases.

The majority of patients with serious congenital heart disease succumb before reaching puberty. Those that survive require evaluation if childbearing is contemplated. In addition to the general physical condition, such factors as cardiac functional capacity, the size of the heart, the degree of cyanosis and polycythemia, and the particular lesion merit special consideration. Cyanosis *per se* is not a contraindication to pregnancy. Pregnancy and labor present such definite risks to patients with coarctation of the aorta that contraception should be practiced in this condition. If it is discovered early in pregnancy, therapeutic abortion is indicated; if the pregnancy is far advanced, delivery should be effected by cesarean section.

Cases of widely patent foramen ovale, interventricular septal defect, and patent ductus arteriosus form another special category by virtue of the possibility of veno-arterial shunt. The judicious use of outlet forceps will obviate undue bearing-down efforts with resulting increased pressure in the pulmonary circuit. In such cases particular attention should be paid to the avoidance of infection.

Patients in Classes 2 and 3 should be admitted several weeks prior to term for rest and study. In such patients with cardiac enlargement digitalis should be used early in labor, before the onset of bearing-down efforts, if the pulse or respiratory rate exceeds physiological levels. The second stage of labor should be eliminated for these patients or appropriately shortened by forceps delivery.

DANIEL G. MORTON, M.D.

LABOR AND ITS COMPLICATIONS

Playfair, P. L.: The Use of Uroselectan B As a Method of Inducing Labor. *J. Obst. & Gynaec. Brit. Emp.*, 1941, 48: 41.

Uroselectan B, a compound containing iodine firmly combined with an organic base, has been used for some time for intravenous pyelography and for amniography in cases of suspected placenta previa, with no apparent deleterious effect upon the mothers. Since labor ensued in many patients shortly after the latter procedure, the drug was tried in 115 cases from the twenty-second to forty-fourth week of gestation as an agent for the induction of labor.

All but 4 cases went into labor within seventy-six hours, which made the rate of success 96.25 per cent. The corrected fetal mortality was 3.6 per cent. The gross morbidity was about the same as with other drugs and better than that with instrumental methods.

The patient could return home to her ordinary life one hour after the injection of the drug. Only local anesthesia was necessary, and there seemed to be no untoward effects upon the mother.

The technique was not complicated. A medium-sized lumbar-puncture needle with stilet in it was inserted midway between the umbilicus and symphysis. After liquor amnii was obtained, 10 c.cm. of Uroselectan B was slowly injected, the stilet replaced, and the needle withdrawn. By exercising gentleness and care, the authors believed that the fetal parts or the placenta should cause no insuperable difficulties. After the twenty-second week of pregnancy they did not fear that the gut might be lying in the track of the needle if the patient had had no previous abdominal operation. E. S. BURGE, M.D.

Sheares, B. H.: The Fetal Abnormalities That Cause Difficult Labor. *J. Obst. & Gynaec. Brit. Emp.*, 1941, 48: 354.

Sheares, of Singapore, presents a concise tabulation and review of fetal abnormalities. The various types he has encountered are described in detail, with particular attention to the history of the type, its relation to labor, the dystocia produced, and the therapy followed. His suggestions are based on experience gleaned in 88 cases, 48 of which caused difficult labor. Ten photographic illustrations augment the text.

In his series, 19 cases of abnormal size of a developmentally normal fetus were noted. Sixty-nine cases of true fetal abnormalities were found with a complicating hydramnios in 59 per cent of the cases. One case of fetal hydrops, 29 of hydrocephalus, 1 of dolichocephaly, 5 of achondroplasia, 1 of iniencephalus, 2 of encephalocele, and 1 of epignathus are discussed. Three cases of hygroma are mentioned. Fifteen cases of anencephalus are included, 12 associated with hydramnios, and 5 with spina bifida. Five cases of fetal ascites were found.

The etiology, diagnosis, classification, and therapy of double monsters are discussed and 2 case reports are made. In the operation of conjoined twins the preliminary diagnostic use of x-rays is advocated.

WILLARD G. FRENCH, M.D.

MISCELLANEOUS

Clayton, S. G.: Fetal Mortality in Postmaturity. *J. Obst. & Gynaec. Brit. Emp.*, 1941, 48: 450.

Clayton of King's College Hospital presents a study of 705 cases of prolonged pregnancy gleaned from the examination of 9,649 consecutive case records. The relationship of fetal mortality to postmaturity is stressed. The criteria of selection of the cases were the continuance of the pregnancy for more than forty-two weeks, a baby weighing more than 7½ lbs., and some associated evidence of fetal overdevelopment. The author states that the number of cases are too small for statistical purposes as regards the mortality rate; yet he concludes that the uniform increase in mortality among the patients with a gestation period of more than three hundred and eight days is very striking, and the results confirm the general clinical impression that the mortality is higher among postmature infants. In 46 cases in which the fetus weighed 7½ lbs. or more and was three hundred and eight days old or older, the mortality rate reported was 10.9 per cent. This figure may be compared to a 5.47 per cent mortality rate found in 8,552 mature cases.

A study of 200 postmature placentas by the x-ray method revealed that, on the average, only slightly more calcification is present in these placentas than in the normal placenta at term. In addition, the general conclusion is reached that "the degree of calcification roughly indicates the degree of villous degeneration, and that both are extremely variable, and only slightly more in the postmature than in the normal cases." The author agrees with Reynolds that the postmature placenta reveals no apparent diminution of the vascular tree.

The paramount causes of fetal death in this postmature series were congenital abnormalities (13 per cent), disproportion and malpresentation (30 per cent), and uterine inertia (30 per cent). In only 2 cases postmaturity *per se* appeared as the apparent cause of fetal death. WILLARD G. FRENCH, M.D.

Turner, C. W., and Meites, J.: Does Pregnancy Suppress the Lactogenic Hormone of the Pituitary Gland. *Endocrinology*, 1941, 29: 165.

Based on experimental evidence, the following theories have been offered to explain the absence of lactation during pregnancy and its initiation following parturition: (a) the placenta produces a suppressing agent during pregnancy which holds lactation in check; (b) the mechanical distention of the uterus by the fetus and placenta inhibits lactation; (c) the secretion of progesterone by the corpora lutea suppresses lactation during pregnancy; and (d) during pregnancy the comparatively large amounts of estrogen present in the blood stream inhibit the lactation process. The sudden removal of the inhibition at

parturition, due to the diminution of estrogen, is then supposed to provide the stimulus for lactation.

The lactogenic hormone of the anterior lobe of the pituitary gland has been shown to be intimately associated with lactation, a factor which most of the theories mentioned fail to take into account. Quantitative studies in the laboratory on the lactogen content of the pituitary gland have demonstrated the important fact that this hormone remains low during pregnancy but increases from two to four fold following parturition. It is suggested, therefore, that the primary reason lactation does not occur during pregnancy is that the lactogenic hormone in the pituitary gland is too low to support lactation.

The cause of the increased elaboration of lactogenic hormone following parturition is unknown at present. It is suggested that lactation such as normally occurs after parturition is possible only when two conditions are fulfilled: (a) a well developed mammary gland, and (b) a high rate of lactogen secretion by the pituitary gland. Of course, this does not mean that lactation is impossible if either condition is only partially fulfilled. Some lactation may occur in a partially developed mammary gland, i.e., a duct system, if sufficient lactogen is present, although the reverse situation is perhaps less apt to occur. On the other hand, these two conditions must be met if copious lactation is to be initiated.

In a series of experiments on rabbits it was demonstrated that pregnancy had no inhibitory effect on the lactogenic hormone of the pituitary gland. On the twentieth day post partum the lactogen content of the pituitaries of 10 rabbits during a period of simultaneous pregnancy and lactation was just as high (27.65 R.T.U. or 1.24 I.U.) as in 10 rabbits which were only lactating (27.10 R.T.U. or 1.22 I.U.). When rabbits were ovariectomized on the twentieth day of pregnancy and killed from two to five days later, their average lactogen content per pituitary gland (10.60 R.T.U. or 0.48 I.U.) was not significantly different from the amount present in the pituitaries of intact animals on the twentieth day of gestation (9.75 R.T.U. or 0.44 I.U.). The placentas of 3 of the pregnant-lactating group were shown to contain lactogenic hormone.

CHARLES BARON, M.D.

GENITO-URINARY SURGERY

GENITAL ORGANS

Huggins, C., Stevens, R. E., Jr., and Hodges, C. V.: Studies on Prostatic Cancer. The Effects of Castration on Advanced Carcinoma of the Prostate Gland. *Arch. Surg.*, 1941, 43: 209.

Since, in many instances, a malignant prostatic tumor is an overgrowth of adult epithelial cells and all known types of adult prostatic epithelium undergo atrophy when androgenic hormones are greatly reduced in amount or inactivated, the authors made serial observations on the levels of acid phosphatase in the series of 21 patients who had been subjected to castration for far advanced or metastatic carcinoma of the prostate.

The objective evidence of benefit after orchidectomy consisted of a great decrease in the levels of serum phosphatase in all but 2 cases, an increase in weight (and appetite), an increase in the red cells of the peripheral blood, a decrease in the amount of pain, shrinkage of the primary lesion, increased density of the metastatic lesions in the roentgenograms, and in 1 case improvement in neurological signs of compression of the cauda equina by metastases.

Untoward effects of castration were temporary swelling of the ankles, development of hot flashes, and abolition of sexual capacity. The hot flashes were eliminated by the administration of estrogen.

Injections of androgen caused an increase of pain.

D. E. MURRAY, M.D.

Smith, R. E.: The Undescended Testicle; Age Incidence—Descent in Relation to Puberty—Possible Indications of Future Descent—Risks of Leaving the Testicle Undescended—the Role of Surgery and Endocrinology. *Lancet*, 1941, 240: 747.

The progress of 50 cases of undescended testicle over a period varying from two to nine years is presented by the author. He concludes from his observations that undescended testicles associated with clinical hernia should be treated surgically. All others should be given the chance to descend spontaneously at puberty. If they do not do so, a preliminary course of hormone therapy, while not often causing descent, will make surgery easier, and orchidopexy should be performed without further delay. Most of the testicles which do not descend spontaneously will be found to be ectopic or to have anatomical obstruction.

D. E. MURRAY, M.D.

Muschat, M.: Cremasteric Spasm. *Arch. Surg.*, 1941, 43: 609.

The cremaster muscle, originating from the lower fibers of the obliquus internus and transversalis muscles of the abdomen, runs along the spermatic cord and then spreads fanwise downward within the cremasteric fascia to envelop the testis and adnexa. The size of these muscle strands varies from 20 to 200 microns in the normal person. The response of the cremaster to stimuli is the same as that of any other striated muscle. It is lowered in atrophy and increased in hypertrophy.

The main complaint, which brings the patient to the physician, is pain of varied degree. The character and degree of the pain depends on the type of spasm in the individual case. In clonic spasm the pain is sharp and radiates upward into the loin, but it lasts only as long as the spasm, usually from ten to twelve minutes. These cases are rare. In the majority of the cases observed the spasm is tonic. The pain is not as severe as in the clonic type but lasts longer and, because of the frequent recurrence, becomes annoying.

There is no report in the literature of the complete bilateral removal of the cremasteric fascia, as carried out in the case reported. A complete and permanent cure was obtained.

JOHN A. LOEF, M.D.

MISCELLANEOUS

Tosatti, E.: The Autograft and Homograft of Renal-Pelvis Material in the Repair of Loss of Bone Substance (L'auto- ed omo-innesto di bacinetto renale nella riparazione di perdite di sostanza ossea). *Arch ital. di chir.*, 1941, 60: 67.

Tosatti exposed the right and left ulnas of 10 dogs, removed a piece of bone 3 to 4 cm. long by subperiosteal resection, and replaced it on the right by a flap of renal pelvis between 3 and 4 cm. long and 2 cm. wide; the graft was autoplastic in 4 animals and homoplastic in the remaining 6. No graft, or merely a piece of renal or splenic parenchyma, was interposed between the stumps of the left ulnas. In 6 rabbits, the author elevated the periosteum of the frontoparietal region of the skull and resected a fragment of bone having a diameter of 15 mm., which he replaced by an autoplastic or homoplastic flap of renal pelvis of the same size. In 4 rabbits, he removed 4 sq. cm. of periosteum of the frontoparietal region of the skull and resected a fragment of bone 15 mm. in diameter, which he replaced by an autoplastic flap of renal pelvis, 20 mm. long and 15 mm. wide, which was applied on the dura mater.

These experiments allowed the following conclusions.

1. Autoplastic grafts of renal pelvis succeed in repairing solidly in the course of from three to five months a loss of substance, 3 to 4 cm. long, in the ulna of the dog.

2. The attempts at repair of lost bone in the control ulnas were absolutely insufficient and in no way comparable to what can be obtained by inserting a renal-pelvis graft between the two fragments.

3. The presence of a tissue different from the epithelium of the urinary passages (renal or splenic

parenchyma) is not capable of determining any ossification between the two stumps of the resected bone.

4. Bone may also be formed between the stumps after insertion of a homoplastic graft of the renal pelvis, but in this case the newly formed bone is scarce, has only a moderate tendency to develop, and never succeeds in uniting the two stumps or in protecting them completely against atrophy, rarefaction, and decrease in diameter.

5. The autoplastic as well as the homoplastic grafts of renal pelvis are capable of causing more or less complete repair of loss of bone substance produced experimentally in the cranial vault of the rabbit.

6. Repair of the cranial vault following autoplastic graft is accomplished in about three months after the intervention; it is constant, solid, and complete.

7. Repair of the cranial vault following homoplastic graft, although considerable, seems to be less solid and less complete and occurs less frequently and later than that obtained by autoplastic grafting of the same material.

As to the importance of the periosteum for the formation of bone, the results of the experiments show that: (1) in all organs there are connective-tissue cells which can be oriented in the osteoblastic direction under the influence of an appropriate stimulus (renal pelvis graft); (2) the periosteum by itself possesses very little osteogenetic power, which is really negligible when compared to that present in grafts of epithelium of the urinary passages; (3) the periosteum is, however, capable of making more solid and more extensive the ossifications due to renal pelvis grafts; (4) the rather modest powers of the periosteum in repairing losses of bone substance may be stimulated and regulated by the presence of certain tissues and organs which may be capable of serving as conducting framework for the proliferating cells of the periosteum.

On the basis of the results which he has obtained, the author discusses and reaffirms the theory which he has previously advanced concerning the mechanism of osteogenesis due to epithelium of the urinary passages, and he proposes a simple biological test to determine which are the grafts that possess a real and specific osteogenetic power: it is sufficient to transplant small pieces of the tissue into the liver and spleen and to observe the result.

RICHARD KEMEL, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Maurer, G.: Regeneration, Dystrophy, and Atrophy of the Limbs — So-Called Sudeck's Atrophy (Umbau, Dystrophie und Atrophie an den Gliedmassen. Sogenannte Sudecksche Knochenatrophie). *Ergebn. d. Chir. u. Orthop.*, 1941, 33: 476.

When a limb suffers injury, reactive changes spring up at the place of injury. The decomposition of the destroyed tissue exercises an irritation on the sympathetic innervation of the vessels. Hyperemia and exudation follow. This results in a change in the chemicophysical character of the blood and tissue fluids, and there follows, on the one hand, resorption and, on the other, regeneration. Acidity of the tissues is necessary in order that calcification of previously formed osteoid tissue may take place and healing be accomplished. The process of decomposition in spongy bone is recognized clearly as a defect by means of the x-rays and is called acute bone atrophy. Both processes of decomposition and repair are taking place at the same time; yet since the osteoid structure does not appear in the roentgenogram, the defects only are shown roentgenographically. In truth the question at issue is not so much one of defect and atrophy as it is one of an active regeneration which can be demonstrated histologically.

This regeneration is a prerequisite to healing; it is not a pathological disturbance, but a physiological reaction to trauma, and so will react to physiological stimuli. If acidosis remains locally in the place of injury, the calcification of the osteoid tissue will be delayed, and the physiologically reactive regeneration will not end in healing but regress and go on to dystrophy and finally to atrophy. This regeneration, dystrophy, and atrophy affect not only the bones of an injured limb but all the tissue, skin, muscle, capsule, and ligaments of the joint, nails, and hair.

The clinical and roentgenographic appearance and the pathological anatomy of this process have been observed carefully and described exhaustively at the Munich Surgical Clinic. Careful research threw much light on the disputed question of predisposition. There was no special distribution according to age and sex. The question of the importance of constitutional reaction to injury was studied. Different studies compelled the authors to assume a predisposition in the patient either to reactive regeneration or to dystrophy, as quite violent injuries in some patients showed only proliferation in the roentgenogram, while minor injuries often showed intense dystrophy in other patients.

No reason could be found in the author's cases for the fact that the duration of the regenerative and atrophic phases varied so greatly in different men. The laboratory findings (blood chemistry, mineral changes, and vitamin determinations) shed practically no light on the question of a constitutional anomaly. It developed that regeneration after trauma rapidly proceeded in patients with the so-called vegetative stigmatization. The authors felt, therefore, that there was a connection between the constitution, dystrophy, and appearance of regeneration, which is of great importance in therapy. It was also determined that the type of body structure was of importance: the athletic type did not tend toward dystrophy, while the very fat as well as the undernourished inclined toward trouble. After repeated observations, the authors formulated a law regarding the site of the appearance of regeneration in respect to favored places in single bones, and in specified bones, and in respect to the neighborhood of the injury.

Observations are then made concerning the biological meaning of the regenerative process and concerning the time of its appearance, which varies with the age, sex, the time of the year, and the kind and severity of the injury. The differential diagnosis considers tuberculosis, syphilis, tumors, and gonorrhea. The prognosis, which is most favorable, is then discussed, and finally the treatment.

The authors believe it is not right to urge those who are injured and in whom there is clinical and roentgen-ray evidence of dystrophy or regeneration to return to work as soon as possible for part pay. Finally, he describes a broader basis for treatment, which has come to have a special significance in the treatment of wounds of war. The treatment should adapt itself to the conditions. In the condition of reactive regeneration the principal demands are rest, and abstinence from stimulants, weight-bearing, and the use of mechanical appliances to the limb. Mechanical exercise and massage should not be used. As soon as the regeneration is complete the limb is moved slowly more and more until normal function occurs. Weight-bearing is allowed only under careful clinical and roentgen-ray observation. The subjective findings of the sick, mainly pain on motion and weight-bearing, are important since they are a measure of the functional capacity.

There are certain cases in the stage of reactive regeneration which in the roentgenogram show patchy shadows and a hazy weak structure of the bone and in which the appearance of repair is very slow. These people usually show marks of vegetative stigmas, and these are the cases which easily slide into dystrophy. These patients should be given tablets of ergocholin, food rich in Vitamin A, and luminal for rest. Meat, salt-free food, and an abundance of milk and vegetables should be prescribed. In cases of dystrophy the limbs have not been used for some time and so require careful treatment. The circulation should be assisted with alcohol rubs and poultices. Slowly, the next step is hot baths and then contrast baths and underwater massage. After this

there should be movements against resistance, active and passive motion, and finally weight-bearing. Only in the most severe cases should one resort to deep roentgen therapy and operation on the sympathetic nerves. It is in these cases of atrophy that treatment by exercise comes into its own.

The most important principles of prophylaxis against dystrophies are then discussed.

(HELLNER). HAWTHORNE C. WALLACE, M.D.

Kornblum, K.: Polyostotic Fibrous Dysplasia. *Am. J. Roentgenol.*, 1941, 46: 145.

The roentgen demonstration of abnormalities of the bony skeleton formed for some time the most important tangible evidence of a somatic disorder in the ever-increasing groups of osteitis fibrosa. With the discovery of the fact that this condition not infrequently is the result of hyperparathyroidism, there appeared important metabolic studies, especially in connection with calcium, phosphorus, and phosphatase activity. First, the tendency prevailed to consider most cystic conditions of the bone as indicative of parathyroid origin, but the metabolic variations soon necessitated further differentiation. In 1938, Lichtenstein separated a group of cases designated "polyostotic fibrous dysplasia," although Albricht described the same condition in 1937 as "a syndrome characterized by osteitis fibrosa disseminata, areas of pigmentation and endocrine dysfunction, with precocious puberty in females." Since then, a few additional cases have been published by Garlock, Horwitz, and Cantarow, and by Moehlig and Schreiber.

In the present article the author contributes 2 more cases; one was proved beyond doubt and the other showed some similarity, but diagnosis could not be confirmed by microscopic examination of the bone specimen. Both cases are reported in detail and illustrated profusely with roentgenograms and photomicrograms.

According to Kornblum, the diagnosis of polyostotic fibrous dysplasia rests upon the following four criteria:

(1) Clinical aspects—the onset of symptoms during childhood; the development of pain, disability, and deformity; and the slow, protracted but progressive course of the disease; (2) the roentgenological manifestations—multiple bone lesions of osteitis fibrosa showing a predilection for the femur and tibia, with a tendency to be predominantly unilateral, and an absence of decalcification of the uninvolved bones; (3) chemical studies—high normal or slightly elevated serum calcium, normal serum phosphorus, a normal calcium balance, and a moderately elevated phosphatase activity; and (4) bone biopsy showing a thinning of the cortex, a replacement of the marrow and spongiosa by dense, gritty, rubbery fibrous tissue interspersed with poorly calcified bone spicules, and an absence of cyst formation. Certainly the most conclusive evidence is the histopathological study of a bone lesion and the diagnosis should not be accepted until substantiated by a bone biopsy.

The etiology of polyostotic fibrous osteitis still belongs to the realm of theoretical conjectures. The congenital nature of the condition is generally admitted but the implication of the endocrine system in its production forms the subject of most controversial argument. T. LEUCUTIA, M.D.

Bennett, G. E.: Shoulder and Elbow Lesions of the Professional Baseball Pitcher. *J. Am. M. Ass.*, 1941, 117: 510.

In a discussion of the shoulder and elbow lesions of the professional baseball player Bennett states that "sore shoulders" can be divided into two rather distinct groups, the anterior and the posterior injuries. In the first group, which is the more common, he places inflammatory and traumatic lesions of the supraspinatus tendon and subacromial bursa, the subdeltoid bursa, the biceps tendon, and of the coracoid bursa. In discussing the underlying pathological changes in the traumatic lesions of the supraspinatus tendon he states that rotation of the humerus with the rubbing of this tendon against the acromion may produce a traumatic irritation or fraying of the tendon. A similar pathological picture can also be produced in the biceps tendon. In analyzing the lesions of the coracoid region, the "follow-through" maneuver of the arm of the baseball pitcher presses the head of the humerus against the coracoid process. The pitcher when using the overhand throw may irritate the supraspinatus tendon, and when using the side-arm type of pitch, may irritate the coracoid bursa. In general the symptoms of the entire group of anterior injuries are sensitiveness about the insertion of the supraspinatus tendon with pain on abduction; while those cases in which the biceps tendon is injured will develop local tenderness in the bicipital groove and discomfort when the arm is flexed against resistance.

The treatment of the traumatic group is rest and local heat unless there is an actual dissolution of the tendons. Before the traumatic basis can be regarded as the only factor in the production of these lesions a routine search for foci of infection must be made, and if purely of inflammatory origin the cases will respond to the removal of the infection and an improved regimen for general health. As a rule, lesions of the anterior shoulder region respond satisfactorily to conservative treatment.

In lesions of the posterior part of the shoulder, the prognosis is not so good. They frequently occur on the posterior inferior border of the glenoid fossa. A deposit of bone strikingly similar to the osteoarthritic deposit one sees ordinarily in much older people appears. This produces irritation of the capsule and of the synovial membrane, as well as pain referred to the deltoid region due to irritation of the circumflex nerve. When the player with this lesion attempts to throw a ball hard, after several innings he suffers so much pain that he is forced to stop. To diagnose a suspected case with this lesion Bennett suggests that the ordinary type of anteroposterior roentgen ray view of the shoulder is inadequate, and

illustrates by diagram a method of tilting the roentgen-ray tube about 5 degrees from the vertical position and taking the picture with the arm in external rotation and marked abduction. The production of this disability is due to the tremendous pull of the posterior portion of the shoulder as the weight of the arm is thrown forward completely across the body at the end of the pitch. After a long period of repeated trauma of the posterior region exostoses or deposits will develop. As this pull on the soft tissues is not severe when a baseball is thrown at moderate speed it rarely causes any discomfort, but it becomes a factor when the player is thoroughly warmed up and pitching hard balls.

The author describes the posterior approach to the capsule of the joint by which the exostoses can be exposed and removed. He sounds a word of warning that absolute assurance cannot be given the player that he will be able to resume his profession following this operation.

A short discussion then follows on the elbow lesions of the professional player, or the so-called osteochondritis; if the loose body formations about the elbow give rise to symptoms their surgical removal is the method of choice. PAUL C. COLONNA, M.D.

Bosworth, D. M.: The Supraspinatus Syndrome; Symptomatology, Pathology, and Repair. *J. Am. M. Ass.*, 1941, 117: 422.

This article is a follow-up of a previous communication of the author which was published in the *Journal of Bone & Joint Surgery*, April, 1940.

Late results in the 28 cases originally reported are noted, and 25 additional cases are recorded. The author's original classification of the pathological lesions was found to hold true for the new cases.

Lesions of tendons, lesions of bursæ, and lesions of bone are the major groups. Two new subgroups were discovered: namely, lesions of the subscapularis tendon (recurrent dislocation), and osteochondritis, either localized or generalized. In addition there were 2 cases with typical symptomatology in which surgical exploration was negative. Follow-up examination in these cases revealed complete recovery.

Symptomatology of the various lesions is reviewed briefly, as is the surgical technique of the author. Valuable conclusions are reached as to prognosis and indications for surgery through a comparison of preoperative and early and late postoperative findings.

The author believes that radical exploration of the shoulder through a division of the deltoid fibers close to their attachment to the acromial margin permits thorough inspection for pathological conditions and produces no permanent defect as far as deltoid function is concerned.

His results show that repair of laceration of supraspinatus and infraspinatus tendons by transplantation is productive of a high percentage of successes.

He also believes that arthrodesis is indicated with certain entities producing this syndrome: namely, complete avulsion of the tendon cuff, massive fibrillation of the tendon, and old crescentic tears.

The fact that early osteochondritis of the humeral head may simulate a supraspinatus tear, as brought out by the author, is well worth knowing.

Excellent sketches of the various lesions and of the surgical technique are presented.

DANIEL H. LEVINTHAL, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Wilson, P. D.: A Simple Method of Two-Stage Transplantation of the Fibula for Use in Cases of Complicated and Congenital Pseudarthrosis of the Tibia. *J. Bone & Joint Surg.*, 1941, 23: 639.

The author first presents a historical review of transplantation of the fibula to replace defects in the tibia. He then presents his own operation which broadens the indication for transplantation. He believes it should be considered in all cases of complicated or infected pseudarthrosis even when there is no gross loss of tibial substance, and particularly when previous bone-grafting operations have failed. It is also valuable in cases of congenital pseudarthrosis.

The operation is performed in two stages. An oblique incision is made over the lateral aspect of the knee, beginning at a point 3 in. above the head of the fibula at the posterior border of the biceps femoris tendon and extending downward and forward to the tibial crest, about 3 in. below the tibial tubercle. The head of the fibula, the lateral surface of the external tuberosity of the tibia, and the tibial crest are exposed. The common peroneal nerve is dissected free and held out of harm by tape. A transverse incision is now made along the inferior border of the tuberosity of the tibia and extended anteriorly and downward to meet the tibial crest. It extends backward to meet the incision which has exposed the common peroneal nerve. The muscle flap which has been outlined is stripped away from its attachment to the fibula and the lateral tuberosity of the tibia and retracted downward. An excellent exposure of the upper part of the fibula is thus obtained. The anterior tibial artery and vein will be seen emerging from the popliteal space and must be ligated and cut.

The fibula is now divided with an osteotome on a slant and a notch cut in the upper end of the tibia to receive it. Because of callus about the pseudarthrosis it may be necessary to produce a green-stick fracture of the fibula in order to wedge it in place. The author at times further fixes the fibula to the tibia by means of a metal screw.

The wound is then closed after replacing the muscle flap in its original position and allowing the nerve to fall back in place. The leg is then encased in plaster.

The second stage is done about four weeks later after the union of the upper end of the fibula with the tibia is secure. A 5 in. incision is made in the long axis of the limb over the anterior surface of the lower third of the leg midway between the tibia and

the fistula. The shaft of the fibula is exposed subperiosteally, and divided obliquely with an osteotome. The lateral surface of the tibia is exposed and a notch cut to receive the fibula and the fibula wedged into the notch. The incision is closed in layers and plaster again applied. Both stages are best done under a tourniquet placed about the thigh.

Complete immobilization is employed for varying periods of months. Generally after about three months a walking stirrup is incorporated in the plaster. The results of such procedure in 9 cases are described. These included 4 adults, of whom 3 had infected pseudarthrosis; the fourth had no infection but pseudarthrosis was still present following two previous bone-grafting operations. There were 5 children with congenital pseudarthrosis or pseudarthrosis resulting from operative correction of congenital bowing, in 4 of whom previous bone-grafting operations had resulted in failure. Bony union of the pseudarthrosis developed spontaneously in 6 of these 9 cases, and in the others supplementary bone-grafting operations resulted in success. Roentgenograms of all cases are presented.

HAWTHORNE C. WALLACE, M.D.

FRACTURES AND DISLOCATIONS

Ordóñez Ferreyra, H.: Supracondylar Fracture of the Elbow with a Vascular and Nervous Lesion in Children (Fractura supra-condilia de codo en el niño con lesión de vaso y nervio). *Bol. y. trab. Soc. de cirug. de Cordoba*, 1941, 2: 130.

A boy, aged seven years, was admitted three hours after a fall on the left elbow which had caused a supracondylar transverse fracture with exposure of part of the upper diaphyseal fragment through a wound of the anterior aspect of the region. The skin of the forearm and especially of the hand and fingers was cyanotic; the radial pulse could not be felt and oscillometry was negative; the sensitivity and motility of the region innervated by the median nerve were greatly disturbed. Immediate operation revealed that the median nerve was lacerated and partly ruptured and that the humeral artery had a dark vinous color, was dilated and soft, and did not beat after being decompressed and washed with tepid physiological salt solution. Higher up, the artery was found to be normal and was ligated 1 cm. above the site where the pulsations began to be observed; the artery was also ligated two fingerbreadths below the elbow where it presented a normal aspect. About 10 cm. of the artery were removed between the ligatures. Then 2 cm. of the median nerve, which corresponded to its damaged portion, were resected and the ends of the nerve were united with superficial fine silk sutures. Recovery was uneventful; the cast was removed after six weeks and functional treatment was instituted; the final result was excellent.

The author calls attention to some articles which have been published recently in Argentina, on closed supracondylar fracture of the elbow with vascular and nervous lesions in children, and suggests surgical intervention as the only means of obtaining healing without sequelæ in cases in which the circulation does not react favorably to reduction of the fracture. It is impossible to establish clinically the degree of the contusion in these closed lesions, and the evolution alone imposes the conduct to be followed: the interval between the accident and the operation will then depend on the gravity of the case and the vigilance of the surgeon. At times, it may be sufficient to evacuate a hematoma, while at times there is a serious vascular lesion which requires arteriectomy as in the present case. However, there is a principal of general surgery which, in case of a wound in the course of a vessel, imposes the necessity of débridement and investigation of the condition of the vessel when there are clinical signs of circulatory disturbance. It is not necessary to go so far as to use arteriography in these cases in order to verify the collateral circulatory capacity. There is nothing to be gained by it as the lesions are already established; on the other hand, it may cause serious damage. The line of conduct to be followed is clinical observation of the patient, and an important factor will be the experience of the surgeon. RICHARD KEMEL, M.D.

Cagnoli, H.: Forward Dislocation of the Lower Extremity of the Ulna as a Sequel to Fracture of the Lower Third of the Radius (Luxación hacia adelante de la extremidad inferior del cubito; secuela de fractura del tercio inferior del radio). *Rev. brasil. de orthop. e traumatol.*, 1941, 2: 365.

Non-traumatic, secondary, gradually appearing forward dislocation of the distal extremity of the ulna following faulty consolidation of the radius is rare and can be avoided by careful anatomical reduction of the fracture; it is a sequel which is always annoying and may cause serious disturbances. Normally, the distal articular surface of the radius presents a slight backward and downward inclination; but, when the fractured radius is consolidated at an angle with an anterior apex, this articular surface becomes more horizontal and turns slightly backward; therefore, the carpus is also carried backward and the anterior radio-ulnar ligament becomes more tense than normally during supination; the result is a tendency toward anterior dislocation of the ulnar head. The constant repetition of this tension of the anterior radio-ulnar ligament leads to its relaxation, while the insidious pathological dislocation of the cubital head is repeated every time the patient executes a complete movement of supination. As preservation of the normal curvature of the radius and of the equality of length of the two lever arms are the principal conditions which dominate the physiology of the forearm and are necessary for the integrity of the movements of pronation and supination, it is evident that the reduction of a fractured radius must be as exactly anatomical as possible in order to obtain a good functional result.

Cagnoli describes 3 cases of forward dislocation of the ulnar head of varying severity. The disturbance was recognizable only during maximal supination in

the first patient; it was more marked in the second and could be observed during the beginning of supination; and in the third it constituted a permanent dislocation and followed a fracture of the radius that had not been reduced. In slight cases, the treatment consists of reproduction of the fracture and correction of the angulation; if this is done, it is not necessary to perform any plastic operation on the ligaments or capsule of the distal radio-ulnar joint. In more severe cases of permanent dislocation, it is necessary to add to the osteotomy of the radius the resection of the lower extremity of the ulna which is the only measure capable of correcting the displacement and its results on the flexor tendons or the median nerve; for this purpose, the same internal approach is used for the resection and, after removal of the lower extremity of the ulna, for the osteotomy.

RICHARD KEMEL, M.D.

Speed, J. S., and Smith, H.: Trochanteric Osteotomy for Ununited Fractures of the Neck of the Femur. *South. M. J.*, 1941, 34: 798.

Operations for ununited fractures of the neck of the femur should accomplish relief of pain, sufficient stability for ordinary weight-bearing, and a fair range of motion. The high (intertrochanteric osteotomy) or the low (Schanz) osteotomy are employed for ununited fractures of the neck of the femur. By doing trochanteric osteotomy, the weight-bearing pedestal is shifted into the weight-bearing line of the body, the shearing force is reduced, and the position of the greater trochanter and the normal leverage action of the gluteal muscles are preserved. The osteotomy operation is considered simpler than the extensive reconstruction or bone-graft operations. High osteotomy is preferable to low osteotomy.

The technique of the operation is through a short lateral incision. A drill is inserted along the contemplated osteotomy line which is slightly oblique. The exact level of the osteotomy is predetermined by an anteroposterior roentgenogram with the drill serving as the marker. The shaft is divided at the predetermined point and displaced medially beneath the femoral head. Another roentgenogram in the anteroposterior view is made to check the position of the fragments. A double spica cast is then applied with the hip in slight abduction and flexion. Eight weeks of immobilization are sufficient.

Fifteen of the authors' 30 cases attained solid osseous union between the head and neck of the femur. Where the head was viable in 16 cases there were 10 unions, and where the head was necrotic among 14 cases there were 5 unions. Seven cases had subsequent osteo-arthritic changes and 1 belonged to the group with poor results. The average shortening of the whole series postoperatively was 1.3 in. Among 30 patients whose average age was sixty years, the results were good in 16, fair in 7, and poor in 7. There was no mortality in this series and the morbidity was low. The authors believe that osteotomy offers a solution to the otherwise hopeless problem presented by ununited fractures to which reconstruction and bone-graft operations are not applicable because of the extensive surgery involved.

RICHARD J. BENNETT, JR., M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Hoyt, L. H., Perera, G. A., and Kauvar, A. J.: Temporal Arteritis. *New England J. Med.*, 1941, 225: 283.

Until recently, the diagnosis of arteritis has been made in most cases by the pathologist. For this reason, the impression was gained clinically that all cases of arteritis and periarteritis were necessarily fatal. More careful observation of the superficial vessels has shown that arteritis and periarteritis are not only more common and more widely distributed than was formerly believed, but that, in addition, the prognosis in certain types is distinctly favorable. During the last few years, arteritis of the superficial temporal vessels has emerged as a distinct clinical entity in which the prognosis is entirely favorable, even though the pathological changes are indistinguishable from other types of arteritis. The authors report the cases of 3 patients who recovered from acute temporal arteritis, the diagnosis having been proved by biopsy.

Historically, acute temporal arteritis has been mentioned in the literature since 1931, and a total of 18 cases have been reported. There is considerable similarity between the cases reported in the literature and the 3 reported by these authors. All of the patients have been elderly people, ranging in age from fifty-five to eighty years. The majority of them have been women. The presenting symptom is usually a severe, boring ache referable to both sides of the head, but usually more severe on one side than on the other. The pain also seems to be more severe at night, so much so that it prevents the patient from sleeping. In some instances the headache is so intense that it is unrelieved by morphine or barbiturates. The temporal regions and temporal arteries may be tender, and during the course of the illness, the vessels may become enlarged, tortuous, and surrounded by areas of hyperemia. Tenderness of the scalp and painful mastication may also be present. The patient may complain of severe generalized symptoms, having the appearance of being severely ill, entirely out of proportion to the amount of local disease present. It is possible that the inflammation of the temporal artery is but a local manifestation of a more widespread disease.

The general lesion is one of chronic periarteritis and arteritis. From a practical standpoint, the most effective treatment seems to be the removal of a segment of the temporal artery. When this is done the headache is relieved, even though the fever and generalized symptoms may continue for as long as several weeks.

It has been suggested that section of the artery severs the sympathetic nerve and in this way eliminates the pain. It is difficult to explain the ultimate relief of generalized symptoms with this treatment. The cause of this localized arteritis is not known. Thromboses of the vasa vasorum might be an explanation, but the reason for thromboses in this area is not apparent. Bacteriological studies have been negative in all biopsy specimens.

HERBERT F. THURSTON, M.D.

BLOOD; TRANSFUSION

Dahr, P.: Blood-Typing Investigations and Medical Practice (Blutgruppenforschung und aerztliche Praxis). *Deutsche Aerztebl.*, 1941, p. 37.

Blood-typing investigations and determinations are important for hereditary investigations and for transfusions. Serologically the four blood groups, $A\beta$, $B\alpha$, AB, and $O\beta$, are recognized. A and B clump blood of Group B. B clumps blood of Group A, AB clumps both, and O clumps none. In spite of this AB is not a universal recipient and O is not a universal donor; in order that the titer of α and β in O blood does not become too high, not over 1:40, the amount transfused should be small, not over 250 c. cm. For preserved donor blood Group O we should pick donors with a low titer, 1:10 or 1:20, then the O blood is harmless even in large amounts. There are in reality not only four groups but six: i.e.,

A_1, Anti-B (Anti-A_2)	A_1 blood, strictly speaking,
A_2, Anti-B (Anti-A_1)	should not be given an A_2 or
A_1B (Anti-A_2)	A_2B recipient. According to
A_2B (Anti-A_1)	newer studies the serum
B, Anti-A	(whether A_1 or A_2) should be
O, Anti-A, Anti-B	tested and designated.

For heredity determination it is important that the blood-cell characteristics which determine blood groups are known to be transmissable and the method of transmission be known; from the three genes, A, B, and O, 6 basic hereditary types and their 6 pictures arise. AA=A. AO=A. BB=B. BO=B. AB=AB. OO=O. From this it follows that AB human beings cannot have any O children nor O human beings any AB children. Among the children there can occur only blood groups that are present in the parents. Of this there are many examples which, however, can be proved only by exclusion. The correctness of this rule has been proved again lately by family investigations. With consideration of the A_1 and A_2 groups there are cases which formerly fell into Group A which can be classified further. The M and N genes, discovered only in 1927, have the same hereditary characteristics as A, B, and O. An N_2 makes the recognition and interpretation just as definite and indefinite as A_1 and A_2. In transfusions M and N need not be taken into consideration. Entirely new is the group P (1929) which was found in 413 families with 1,289 children (112 families with 300 twins); it has been identified but not studied sufficiently. EZ are entirely similar in blood grouping, but ZZ need not be. In racial hygiene, as a

means of anlage investigations and disease prevention we must consider A_2, N_2, and P, so that possibly immune human beings, i.e., against poliomyelitis, may be found. The blood grouping is possible even in dried blood so that blood from a nose bleed cannot be confused with that of a murdered individual.

(EGGERT). LEO A. JUHNKE, M.D.

Czekalowski, J. W.: Studies on Stored Blood. The Effect of Sodium Sulfapyridine, Albucid Soluble and Hydrogen Ion Concentration on Phagocytosis. *Edinburgh M. J.*, 1941, 48: 405.

In this study, two drugs were used for the investigation *in vitro* of the phagocytosis of streptococcus viridans greening, Type R, viz.; (1) dagenan sodium, that is, sodium sulfapyridine, and (2) albucid soluble. The methods pursued in this study, together with the technique of the experiments, is described.

In the investigation of phagocytosis, the number of ingested cocci in 100 consecutive polynuclear leucocytes was counted. From this total, the average number of ingested cocci per leucocyte was figured; that is, the index of the phagocytic system and the percentage of leucocytes active in phagocytosis was estimated.

Using streptococcus viridans greening, Type R, the authors note that the phagocytic index and the percentage of leucocytes taking part were both increased by (a) sodium sulfapyridine in concentrations of from 33.3 mgm. to a liter, to about 0.66 or 0.33 mgm. to a liter; and (b) albucid soluble in concentrations from 6.66 to 0.33 or 0.22 mgm. to a liter.

These effects were maximal with sulfapyridine at a concentration of 6.66 mgm. to a liter, the phagocytic index being increased by 44.9 per cent and the percentage of leucocytes taking part by 111 per cent; while with albucid soluble at a concentration of 3.33 mgm. to a liter, the phagocytic index increased 97 per cent and the percentage of leucocytes increased 106 per cent.

Albucid soluble had a greater effect on the phagocytic index than had sulfapyridine, but about the same effect on the number of leucocytes taking part.

Sulfapyridine and albucid soluble in relatively high concentrations decreased both the phagocytic index and the percentage of leucocytes taking part. This effect appears to be inherent in the drugs and not to be due to a coincidental change in pH. Over the range 6.2 to 9.05, pH had no definite effect on phagocytosis. At pH values near 9 and after incubation for a long time, there was, however, a slight tendency for the index and also the percentage of cells taking part to increase.

The authors noted that in a number of films large mononuclear cells were observed taking part in the phagocytic action. These were more noticeable in the systems with solutions of albucid soluble, but they were also seen in the control phagocytic systems. The number of these cells and the number of ingested cocci, however, were too small to warrant any conclusions being drawn from this fact.

It was considered that both of the drugs used in these experiments acted not as an opsonin but as a stimulus to polynuclear leucocytes.

HERBERT F. THURSTON, M.D.

McEachern, A. C.: The Selection of a Method of Blood Transfusion. *Med. J. Australia*, 1941, 2: 290.

The author notes that in Australia, the private practitioner must be prepared to carry out blood transfusion in either well equipped or poorly equipped private hospitals or sometimes in a private home. In each case he will provide his own apparatus and must be prepared upon occasion to work with a staff not quite familiar with blood-transfusion procedure. Private practice also has its own problems when the question of preparation and sterilization of equipment is considered. It follows from the conditions outlined that a method is required which is reasonably simple, which makes no undue demands upon the operator and his staff, which fulfills the modern requirements of easy cleansing and sterilization, and which is readily available. Continuous drip methods have come to stay, and of necessity have to be managed by the nursing staff. The claim for use of the commercially prepared vacuum flasks under these conditions is unassailable.

For simplicity, it is essential that the citrate solution should be supplied in the flask, permanent sterility being ensured by sterilization *in vacuo*. Several types of flasks are available in Australia, and, of these, the author recommends a two-hole proprietary flask for blood transfusion in private practice. The adaptability of the Bonnin plug can be increased satisfactorily, and its minor defects can be overcome if the plug is adapted for the use of negative pressure. This can be done by extension of the air vent so that a sterile air filter can be attached. Details of this adaptibility are presented and by its use gravity or negative pressure can be used at will. This combination is simple and lacks the defects of other current methods.

Ordinarily, gravity is all that is needed or desirable to regulate the drip in the administration of blood; but when small needles and cannulae are used, the patients are suffering from shock, or the patients are infants, sometimes a delay in flow will occur and will be shown by a slowing up of the rate of drip and a rise of the level in the drip tube. When necessary the Riddell rotary pump has been used as a drip regulator; it may be used temporarily to increase the flow.

For use in institutions, a standard 1 liter bottle is satisfactory and is suspended by a simple attachment. This is described in detail. Although the gravity technique has so far superseded the older methods, the two-way tap gave such good service over a period of years, and is so simple and reliable, that it is worthy of mention. The writer describes a simple two-way tap method.

Reference is made to blood transfusion during transport. The importance of efficient cleansing of

the apparatus is stressed and an efficient technique is described. Adequate cleansing is a fundamental factor in the avoidance of reactions and has a direct bearing on the selection of the apparatus and methods of procedure. HERBERT F. THURSTON, M.D.

McLean, J. A.: The Treatment of Certain Blood Diseases and of Hematemesis by Direct Blood Transfusion. *Med. J. Australia*, 1941, 2: 281.

In adopting the conception of the blood as a living tissue, it would seem that in respect to blood transfusions, the direct transfusion of unmodified blood is the ideal method. Thus the time interval is too short to allow cellular change and moreover there is no anticoagulant which may initiate changes in the plasma. From an experience of over 100 direct blood transfusions, the author notes that two main points emerge. First, a stimulating effect on bone-marrow function is obtained by the direct method, and second, in the treatment of recurrent hemorrhage, particularly from peptic ulcer, cessation of bleeding has been obtained in cases in which previous continuous drip transfusion of citrated blood has been ineffectual.

At first the author used the multiple syringe method in direct transfusions. Later he employed a rotary pump of the Riddell type. Still later a new type of rotary pump led to a simple and effective type of procedure. A special needle and cannula tourniquet is described.

The author presents in detail the history of 2 patients suffering from aplastic anemia. One patient received ten transfusions of citrated blood with temporary improvement, then seven direct blood transfusions with more sustained improvement and final recovery. The other patient received twenty-two direct blood transfusions in twelve months.

Four patients with acute purpura hemorrhagica were treated by direct blood transfusion; subsequently, bleeding ceased and an increase in the number of blood platelets occurred with a diminution of the bleeding time. One patient had previously been treated unsuccessfully by repeated drip transfusions of citrated blood; bleeding was subsequently controlled by direct blood transfusion.

The effect of direct blood transfusion on a patient suffering from lymphatic leucemia was to treble the number of white cells. The therapeutic value of deep x-ray therapy was enhanced by preliminary direct blood transfusion. Seventeen patients suffering from hematemesis due to peptic ulcer were successfully treated by direct blood transfusion. Four patients in this series had previously been given continuous drip transfusions of citrated blood which had been ineffectual in controlling the hemorrhage. The author noted a rapid increase in the hemoglobin value in 1 of these 4 cases. An increase of 1 per cent per day is regarded as the approximate normal rate; but in this particular case, the hemoglobin value increased as much as 47 per cent in fifteen days after direct transfusion.

The author concluded from the results in this small series of cases and from previous experience with transfusion of citrated blood, that as a hemostatic in the treatment of hematemesis the direct method is preferable. In other acute hemorrhagic conditions, a similar satisfactory result was obtained. Patients suffering from severe hemorrhage due to various causes, such as post-partum hemorrhage, ectopic gestation, placenta previa, acute menorrhagia, severe epistaxis, and excessive rectal hemorrhage have been successfully treated by direct blood transfusion.

HERBERT F. THURSTON, M.D.

SURGICAL TECHNIQUE

WAR SURGERY

Hume, E. E.: Training of Medical Officers for War Duty; Work of the United States Army's Medical Field Service School. *War Med.*, 1941, 1: 624.

Military medicine entails much more than treatment of the sick and wounded men in uniform. In the past this specialty suffered because at the end of each war medical officers returned to civil life and rapidly forgot their lessons in military medicine. The result was that the Medical Corps of the Army was unable to do more than perform its curative medical functions, with little or no time to study large problems. After the World War the National Guard in some states began to develop a Medical Corps by means of which the facts that one generation learned in practice could be expanded by theoretical studies so that the next generation would have a basis on which to build. Also, in 1908, the Medical Reserve Corps had been created, which made it possible for medical officers to keep alive their interest in military medicine by means of periods of active duty and correspondence, and other courses offered by the Army. The next development was the establishment by the Surgeon General in 1920 of the Medical Field Service School for the teaching of medical officers and men of the Regular Army, the National Guard, and the Reserves. This school was designed to give its students the very things they could not learn in Medical School, so that the two schools would be complementary in scope. It stressed preventive medicine particularly. The home of this Medical Field Service School since its inception has been the Carlisle Barracks in Pennsylvania.

The objects of the Medical Field Service School, as set forth in Army Regulations, are:

1. To instruct and train Medical Department officers of the Regular Army, National Guard, and of the Officers' Reserve Corps in the principles and methods of medical field service so as to increase their ability as instructors and to enhance their proficiency in the performance of their command and staff duties.

2. To instruct and train selected enlisted men of the Medical Department of the Regular Army, National Guard, and Organized Reserves in the duties of non-commissioned officers pertaining to the organization, mobilization, training, and operation of Medical Department units of the components of the Army of the United States.

3. To act as an agency of the Surgeon General in the development and perfection of the principles and methods of medical field service.

4. To assist in the development of medical field sanitary equipment; to assist in the preparation and revision of Medical Department training regulations, instruction manuals, and other publications; to make research in matters pertaining to the field duties of the Medical Department; to disseminate to the service information pertaining to instruction and training used and developed at the Medical Field Service School.

Students for each of the courses of instruction at Carlisle Barracks are always appointed by the War Department, on the recommendation of the Surgeon General. With the President's declaration of the existence of a limited emergency, the type of instruction has been changed since July, 1941, from six-month training courses to shorter "refresher" courses, lasting one or two months each and consisting of a review of the fundamentals of medical field service, together with recent changes and advances. The Departments of the Medical Field Service School include administration, military sanitation, military art, training, logistics, field medicine and surgery, veterinary medicine, dental medicine, and other special departments such as equitation, chemical warfare, aviation medicine, and public speaking. The functions of each department are outlined. The school is housed in recently erected modern buildings. Officers are taught how to construct the devices used in the field for the purification of water, and the disposal of wastes. A Sanitary Area has certain of these permanently set up, and others are erected at the time of demonstrations. The Thirty-Second Medical Battalion has been created as a medical regiment and serves now as demonstration troops. Student officers at the Medical Field Service School not only witness the work of the battalion but participate actively in it, thus learning first hand the technique of evacuating wounded men, the handling of litters, medical supplies. Publications include the Army Medical Bulletin, the Dental Bulletin, the Veterinary Bulletin, and special texts and instructional material published from time to time. Attached to the School is a Medical Department equipment laboratory where new articles of equipment are created, developed, and tested.

The Medical Field Service School teaches its students map reading, the functions and problems of the entire modern military machine, the problems of transportation of food, fuel, ammunition, the general principles of military law, the customs of the military service, and the accounting for supplies and material in general. The men must learn equitation, the planning of training programs in peacetime and war, and, most important of all, the basic principles of preventive medicine, and the broad laws of hygiene and sanitation.

Over 19,000 men have already completed training at the school. To this institution is entrusted the task of training medical officers to preserve the lives and health of the men who have answered the call of duty and are defending the American way of life.

EDWIN J. PULASKI, M.D.

Besser, E. L.: Stored Dextrose-Citrate Plasma in the Treatment of Operative Shock. *Arch. Surg.*, 1941, 43: 451.

The value of plasma in the treatment of shock has been clearly established. Because plasma can be administered without regard to blood groups, can be prepared from stored whole blood, and can be stored for long periods and remain efficacious, it is a valuable addition to our therapeutic armamentarium. The author reports experiences with dextrose-citrate plasma transfusions given to 26 patients who manifested shock during operations. He has found it practical to consider "shock associated with operations" as a broad term describing a state of circulatory insufficiency in which there is a fall of the systolic blood pressure below 80 mm. of mercury.

Detailed data on 18 of the cases is presented. This consists of hematocrit determinations before operation and during recovery, and the estimated amounts of blood lost during the operation and the recovery with plasma transfusion. In this series, treatment of shock was started immediately on development, and the response to plasma transfusion was rapid and favorable in all cases. JOHN A. GIUS, M.D.

Alexander, A. B.: Rupture of the Drumhead as a Wartime Injury. *Brit. M. J.*, 1941, 2: 195.

Rupture of the tympanic membrane is one of the commonest of all types of injury under air-raid conditions. In peacetime, rupture of the membrane is a slight injury because it follows an uncomplicated course. When the rupture is due to the blast of high explosive bombs it is serious and is frequently complicated by infection. A whole chain of otogenic complications may follow, from slight persistent deafness to death from meningitis. Aside from ruptures caused by extension of fracture from the cranial bones, textbooks usually describe direct and indirect traumatic ruptures. For practical purposes the author differentiates ruptures which leave the tympanic cavity most probably sterile and those in which the cavity becomes contaminated. Ruptures of the drumhead caused by blast are regarded as belonging to the latter group since foreign matter carried by the blast is likely to enter the tympanic cavity.

In air-raid casualties, symptoms of rupture are often masked by the presence of more severe injuries and, unless routine otoscopy is done, are often overlooked until suppuration occurs. The usual symptoms are pain at the moment of rupture, tinnitus, initial vertigo, and moderate reduction of hearing. The vertigo is due to caloric stimulation and is not a result of concussion of the labyrinth. Examination reveals the rupture with hemorrhagic staining of the margins of the perforation. Interstitial hemorrhages in the membrane are common and minute black spots due to impregnation of solid matter carried by the blast are sometimes found. The meatus may be blackened by soot. The use of the ear syringe is strictly contraindicated. Sterile forceps may be used to remove small coagula or wax in order to inspect the drumhead. It is advisable to test for reduction of the perception of high sounds and for nystagmus, other than the findings produced by caloric influence, since these indicate damage to the labyrinth.

The clinical course falls into one of three categories:

1. The uncomplicated case in which regeneration of the drumhead occurs, and complete healing of the perforation ensues in an average of about twenty-five days, with hearing returning to normal.

2. Infection of the tympanic cavity of low virulence with seropurulent discharge lasting from a few days to several weeks, followed by scarring or persistent perforation. Some degree of middle-ear deafness usually results.

3. Infection of the tympanic cavity of high virulence with major inflammatory reactions appearing within from twelve to twenty-four hours after the injury. Fifty per-cent of the cases caused by air raids which were observed by the author showed some infections of the tympanic cavity.

The treatment of uncomplicated cases consists of protecting the cavity by lightly plugging the meatus with sterile cotton. The patient is warned about care in bathing or washing, so that water does not enter the canal, and is advised to avoid violent exercise which might cause sweat to accumulate in the meatus. Recently the author began to employ sulfanilamide insufflation of the tympanic cavity routinely as a prophylactic measure. He believes that this measure reduces to a minimum the occurrence of suppuration in a presumably infected tympanic cavity. In cases already suppurating he did not observe any benefit as the powder was carried away by the discharge. The oral administration of a sulfonamide is recommended in acute otitis of traumatic origin. The technique of powder insufflation of the tympanic cavity is described.

JOHN L. LINDQUIST, M.D.

Abruzzini, P.: Methods of Treatment of War Wounds of the Neck and Thorax (Indirizzi di cura nelle ferite di guerra del collo e del torace). *Minerva med.*, 1941, 32: 560.

The sooner war wounds of the neck and thorax can be treated, the better. Many wounds of the neck are immediately fatal and do not even reach the first aid station. Sometimes, however, projectiles pass through the neck without injuring the great vessels. In such cases treatment is limited to cleansing the wound, applying protective dressings, and sending the patient back to the nearest hospital. If there is hemorrhage an effort should be made to locate the bleeding vessel and ligate it. Wounds of the larynx and trachea are generally serious. The chief symptoms are dyspnea, bloody expectoration, and emphysema which increases visibly with every attack of coughing. If there is severe edema or threatened suffocation, a rapid high tracheotomy should be performed and every physician at the front should know how to perform it. If the patient can wait some hours he should be sent back to the

nearest hospital. In injuries of the pharynx and esophagus there are dysphagia and bloody expectoration. As a rule these are not emergency cases and can be sent back to the nearest hospital. If projectiles are lodged in the deep tissues of the neck the patient should be sent back to a post where there is an x-ray apparatus so that the projectiles can be localized accurately. They should be extracted as quickly as possible to prevent irritation and injury of the vessels and nerves.

In injuries of the nerve trunks, suture should be performed as soon as possible, but since suture of the nerves requires great skill and since surgeons with the necessary skill and practice are not often found at the front line posts, the patient must in most cases be sent back to a hospital; nor should alcoholization of the intercostal nerves generally be attempted at the front.

Injuries of the thorax may involve only the wall and in that case it is necessary only to cleanse the wound and remove any foreign bodies. However, if they involve the mediastinum, heart, or lungs the situation is more serious. If the lungs are injured and there is hemorrhage the accumulated blood should be removed and air injected. If there is internal hemorrhage the patient should be given a blood transfusion. If there are injuries of the mediastinum, expectant treatment is indicated. In large lacerated wounds of the chest the wound should be closed by means of compresses fastened in place with adhesive tape. Bandages should not be applied tightly around the whole chest for fear of interfering with the compensatory action of the sound lung. The patient should be given morphine to control cough and dyspnea and sent to the nearest surgeon. In injuries of the lung the patient should be operated on under anesthesia with hyperpressure which keeps the lung expanded and prevents dyspnea from the trauma. In wounds of the heart it may be necessary to operate in order to save the patient's life. In injuries of both the abdomen and thorax it is generally preferable to perform the abdominal operation first. In injuries of the nerve, crushing of the phrenic nerve to paralyze the diaphragm and prevent further injury of the injured lung is often indicated.

The author describes 4 unusual cases in his practice: one of a grenade fragment which had passed in the right mandibular region and lodged between the esophagus and cervical spinal column to the left of the midline. An abscess had formed there. The foreign body was removed in time to prevent extension of the suppuration to the mediastinum. The second case was that of an officer who had been picked up on the field by his men who thought he was dead. There was a large wound from grenade fragments in the left subclavicular region, with comminuted fracture of the first rib, involvement of the pleura and lung, pneumothorax, and hemothorax. The wound was cleansed and the wall closed and a transfusion given. The patient recovered. In the third case fragments had fractured the seventh and eighth ribs, had changed their direction and injured the apex, and had lodged in the supraclavicular region. They were removed and the patient recovered. In the fourth case a projectile had entered the lung, passed through the diaphragm, and entered the stomach. The diaphragm was sutured, the spleen removed, and the stomach sutured. The projectile had evidently passed out with the stomach contents. AUDREY G. MORGAN, M.D.

Roberts, J. E. H., and Tubbs, O. S.: Recent Experience with War Wounds of the Chest. *Am. J. Surg.*, 1941, 54: 289.

During the latter part of the last war much interest became focused on wounds of the chest because of the new conception that thoracic injury should be treated on the same principles as wounds elsewhere on the body. During the subsequent years of peace, steady progress was made in thoracic surgery. The prelude to the present vast conflagration occurred in Spain and those responsible for the care of chest wounds in 1939 naturally sought the experience of surgeons of Spanish casualties. Jolly leaves the impression that few primary intrathoracic operations were performed for he states, "The outlook for all cases requiring an intrathoracic operation is grave," and, "a lung abscess developing later in a living man is to be preferred to an aseptic thoracic cavity in a dead one." In general, Jolly recommends the conservative treatment in vogue during the early phases of the 1914 war. It appears, therefore, that no advance in the care of thoracic wounds evolved from the Spanish Civil War.

A considerable amount of material has been written on chest wounds since the outbreak of the present war, but for the most part the opinions expressed are based on experiences of over twenty years ago. The authors believe that this is due partly to the fact that military casualties have been mercifully few and that chest wounds in civilians resulting from aerial bombardment tend to be severe and often result in death before reaching the hospital. A few of the 1920 conceptions of wounds of the chest have been modified or have been confirmed during the past two years. These have to do with the personnel of the individuals caring for those wounds. A discrepancy in the results given by different operators is at first confusing, but this discrepancy is readily explained by the fact that there are a very large number of general surgeons with excellent training, but less than 5 per cent of these are accustomed to thoracic work. Transportation also has its effect upon those patients suffering from thoracic injury. The authors cite hemorrhage as the chief complicating factor during transportation.

During the last war it was noted on many occasions that men might be found dead in the immediate vicinity of an explosion without external evidence of injury. Experimental work offers the explanation that death is the result of "blast" or pulmonary concussion. At present pulmonary concussion should be suspected in any patient found close to the site of the

explosion, particularly if there is cyanosis, marked shock, dyspnea, diffuse chest or abdominal pain, scattered pulmonary râles, or abdominal rigidity unaccounted for by any other injury. Since the aerial bombardment of the civilian population started, the proportion of closed to penetrating injuries has steadily increased, presumably as a result of the population's taking more adequate protection. In the absence of pleural penetration the authors have no comment to make on the well established principles of treatment formulated twenty years ago. In patients who do not require primary operation except for excision of entry and exit wounds, the treatment of hemothorax has been revised during the last two years. In the past it was customary to await the absorption of the blood. The disadvantages of such expectant treatment are: (1) an excellent bacterial culture medium remains in the pleural cavity and thus encourages infection, and if it occurs, the subsequent empyema is frequently very large; (2) the absorption of blood is often slow and the deposition of fibrin on the pleural surfaces is sometimes progressive; therefore, this fibrin becomes organized and hampers pulmonary re-expansion.

It is now a general routine to aspirate as much blood as possible about twenty-four hours after the injury and always before the fourth day. The fluid is removed as long as it can be withdrawn through a large bore needle. Often it is necessary to introduce a little air to relieve the increasing negative pressure. Treatment of an infected hemothorax is exactly similar to that of an acute empyema. The authors then give the indications for primary operation and also the technique of the primary operations. The question of chemotherapy and that of the surgical procedures was discussed.

PAUL MERRELL, M.D.

Hayward, N. J.: Rapid Identification of Clostridium Welchii by the Nagler Reaction. *Brit. M. J.*, 1941, 1: 811.

Using the Nagler reaction—the production by clostridium welchii of turbidity and sometimes a fine curdiness in human serum—the author describes a method of rapid identification of this organism from initial cultures. She points out that the production of a "stormy" milk clot is frequently slow and often not attained on the first attempt. The method used consists in the preparation of test and control tubes; the test tube contains human serum and Fildes' broth, and the control the same, along with a 10 per cent dilution of concentrated welchii antitoxin. The tubes are inoculated and read up to sixty-four hours after incubation at 37°C. under anaerobic conditions. A positive reaction is denoted by turbidity of the serum, and in strong ones a fine yellow curd may float on the surface. The control tube shows turbidity due to bacteria only, and a sediment with clear supernatant remains after centrifugation. It is important that a sufficiently large inoculum be used. Human serum broth is the best medium and solid media give even a more rapid result. Commercial antitoxin was used. The best broth medium was discovered to be Fildes' iron broth. Strict anaerobiosis was found to be unnecessary.

Fifty-eight strains were tested, 55 of them recently isolated cultures. Ninety-six per cent (56) gave strong positive reactions, and the 2 remaining reacted feebly. The test was made on 174 other anaerobes of several different types, and of these 165 gave no Nagler reaction. The 9 remaining produced feeble but definitely positive reactions, the controls being negative. It is possible that these strains were not pure, and that the positive reactions were given by a contaminating clostridium welchii.

The author states that the Nagler reaction allows 35 per cent more positive reactions for clostridium welchii than does the old method with milk. It is a specific test, although there are some feeble nonspecific reactors. The result may be obtained ultimately within two or, at the most, three days; on solid media, reactions are frequently produced in twenty-four hours. HENRY P. ROYSTER, M.D.

DeGowin, E. L., and Hardin, R. C.: A Plan for the Collection, Transportation, and Administration of Whole Blood and of Plasma in Warfare. *War Med.*, 1941, 1: 326.

In the light of recent development of war medicine one of the urgent needs has been the perfection of a satisfactory method of supplying blood or blood products to the injured soldier with as little delay as possible. With this purpose in view the authors have devised a technique, as well as equipment, for the processing and administration of blood and plasma under conditions conceivably encountered during warfare.

Briefly, the equipment is composed of a "closed system" of blood collection and administration utilizing a "transfusovac" flask which contains a dextrose, citrate mixture for the prevention of clotting. The details of separation of plasma, refrigeration, temperature control indicators, and transportation methods were all carefully investigated and described. With their methods, the authors demonstrated the safety and practicability of storing blood for thirty days with adequate refrigeration, and of transporting it with mobile refrigerator units as far as 700 miles by car and 3,500 miles by air.

STANLEY ROBBINS, M.D.

OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Sears, H., Smick, W. E., Schauffler, G. C., and Shoemaker, R. C.: A Quantitative Test to Evaluate Methods of Hand Sterilization. *West. J. Surg., Obst. & Gynec.*, 1941, 49: 458.

In seeking a reliable test of the efficiency of various methods of hand sterilization with the object of preventing postoperative infection, the authors adopted the technique generally used for the total bacterial count of water and milk. As a basis for computing the reduction in bacterial count pro-

duced by scrubbing they used the sample produced by brushing the hands for one minute with a sterile brush into a basin containing a measured amount of sterile water. In 6 subjects four minutes of mechanical cleansing caused a reduction of from 37 to 57 per cent of the organisms. In the same number of subjects an average reduction of only 4.5 per cent followed two minutes of scrubbing as compared with 11 per cent after three minutes, 42 per cent after four minutes, 61 per cent after six minutes, and 72 per cent after twelve minutes. In 1 subject a 42.5 per cent reduction occurred after four minutes of mechanical cleansing, and after such cleansing a reduction of 79.7 per cent was produced by rinsing the hands for one minute in 70 per cent ethyl alcohol. Mercuric chloride was less, and iodine more effective.

The method used admittedly does not take into consideration the number and type of organisms that may be left on the hands. In the opinion of the authors it merits further study especially in the direction of cautions and conservative application to the value of hand preparation methods.

WALTER H. NADLER, M.D.

McPheeters, H. O., and Nelson, H.: The Blanket Split-Skin Graft for Covering Large Granulating Areas. *J. Am. M. Ass.*, 1941, 117: 1173.

Small granulating areas can be easily and quickly covered by most of the accepted techniques with the razor grafts of Blair and Brown and their associates or with the small deep grafts of Davis. In the resurfacing of large areas, however, these methods have definite shortcomings, most of which can be avoided by the use of the calibrated grafts as taken with the Padgett dermatome.

Using this apparatus, the authors have fashioned what they term "blanket grafts," which are particularly adapted to and used in covering an extensive granulating area such as an entire thigh, or a large part of the back or body elsewhere (Fig. 1).

In one particular case one graft was prepared with a total area of 176 sq. in., or 1,100 sq. cm., and a second graft of 149 sq. in. or 931.25 sq. cm., the first graft taking 92 per cent and the smaller graft 90 per cent, so that no subsequent grafting was necessary.

The technique is as follows:

A pattern of the area to be covered is made by tailoring a sheet of gutta-percha to fit it exactly. This is then pinned on an ordinary drawing board covered by a warm moist towel. The grafts are then placed over this pattern one after the other and sutured together to conform to the pattern. The excess skin over the edge of the pattern is trimmed off and sutured elsewhere. It is then a simple matter to apply this "blanket graft" over the entire granulating area at one time and adjust it to fit. The graft need not be sutured to the granulations, which bleed so easily, but only to the edges of good skin on all sides.

It is of the utmost importance that all the principles of skin grafting be followed here as elsewhere.

Fig. 1. Large blanket graft: seven drum sheets taken from patient's back.

The grafts must be kept moistened with warm physiological saline solution all the time. They must be immobilized and held firmly in place for at least five days without dressing; then firm pressure should be continued for the next week. At each dressing great care must be used not to lift off the graft that is just beginning to adhere. Grafts over granulating surfaces must be kept continuously moistened with physiological saline solution after operation. Piecrusting the grafts prevents the accumulation of serum. Support must be maintained to the area to prevent accumulation of edema until the graft has taken well and has become normal skin once more.

The technique and general principles used by the authors are those advised and recommended by Sumner L. Koch in "SURGERY, GYNECOLOGY AND OBSTETRICS" in 1941. SAMUEL H. KLEIN, M.D.

ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Van den Ende, M., Edward, D. G. F., and Lush, D.: Reduction of Dust-Borne Infection by Treatment of the Bedclothes. Experiments with Antiseptics; Treatment of Textiles with Dust-Laying Preparations. *Lancet*, 1941, 240: 716.

The importance of airborne and dropletborne infection has been stressed in the past. Dustborne pathogenic organisms have been shown to be prevalent in hospital wards, and the authors emphasize that this source of dissemination is frequently derived from the bedclothes. Their efforts were turned toward the prevention of the scattering of dustborne organisms through movements of the bedclothes. First, cotton and woolen samples were impregnated with various antiseptics, sprayed with organisms and cultures taken two hours later. Hexyl resorcinol, resorcinol alone, resorcinol (with glycerine, with cetyl pyridinium bromide, or with both), carvacrol, and chlorcarvacrol were all found to be effective. How-

ever, samples that contained the drugs in sufficiently high concentration proved to be too malodorous or hard. Consequently, this method of investigation was abandoned.

Experimentation showed that cotton and woolen cloths could be optimally treated with a 30 per cent solution of medicinal liquid paraffin in a light petroleum product (white spirit), and, after the excess was removed by extraction and drying, could be used comfortably. About 2.5 per cent and 6.5 per cent of the white spirit was retained in the wool and cotton, respectively. The material was then impregnated with paraffin. Blankets and sheets so treated were sprayed with cultures of staphylococcal and streptococcal organisms, and the content of dust particles and organisms were collected and compared with a control series. The percentage reduction of the organisms compared with the control varied between 89 and 100 per cent, which represented a significant difference. The reduction in floating bacteria was roughly proportional to the number of floating dust particles.

A clinical test was devised, several blankets used in air-raid shelters being paraffinized and the bacterial content compared with a set of controls, all in use for sixteen days. Results showed that the ratio of total organisms liberated from treated and untreated blankets was 1:11. In spite of the excellent results, the present method of cloth impregnation is not practicable, but the authors do advocate a trial of the method in hospitals treating infectious diseases. A substance which will easily and effectively impregnate bedclothes should be sought.

HENRY P. ROYSTER, M.D.

Bigler, J. A., and Werner, M.: Active Immunization Against Tetanus and Diphtheria in Infants and Children. *J. Am. M. Ass.*, 1941, 116: 2355.

It is known that active immunity is much more preferable than passive immunity, since the duration is longer and the serum sensitivity factor is eliminated. Alum-precipitated toxoids of tetanus and diphtheria bacilli apparently satisfy the quest for potent immunizing agents against tetanus and diphtheria. The results in the case of diphtheria have been amply proved and numerous authors have demonstrated the effectiveness of tetanus toxoid in raising the antitoxin titer. There is as yet no evidence that tetanus-spore infection will cause a rise of antitoxin in previously immunized human blood. The necessary level of antitoxin is not exactly known, but in the horse has been found to be from 0.1 to 1 unit per c.cm., and at times as low as 0.001 unit. There is no simple guiding test in tetanus immunity as the Schick test for diphtheria. The efficacy of active immunization of alum-precipitated toxoid has been proved in animals, but tetanus infection does not greatly accelerate the production of antitoxin in previously immunized guinea pigs. Universal use of active immunization with tetanus toxoid for horses and men in the French army for several years has reduced the occurrence of tetanus to almost nil, and no case has been reported in an immunized subject.

The use of two antigens, although not new, would seem logical, especially in the case of children. The material consisted of unmodified (treated with formaldehyde) and alum-precipitated combined tetanus and diphtheria toxoid, and alum-precipitated toxoid. The dosage was standardized throughout the series.

Two hundred and forty infants and children from eight months to six years of age, were given active immunization. All received injections of the combined diphtheria and tetanus toxoids and all had repeated determinations of their blood antitoxin at varying intervals after the first, second, and third injections, and from one to two weeks after the third injection, and again later in the year. Primary or basic immunity was established by two or three subcutaneous injections at different times. In 55 of 69 patients the blood antitoxin rose to high levels after the first injection of 2 c.cm. of toxoid, and this was maintained above 0.2 unit per c.cm. for a three-month period. After a second similar injection the rise was even higher, averaging 3.5 units per c.cm. on the seventh day after injection. The titer then fell rapidly, being 0.22 unit per c.cm. in 21 months. There were two failures in the group. The response was found to be adequate in a smaller series of children when half the dose was given, but the antitoxin titers were not so high The unmodified toxoid gave lower titers than the alum-precipitated material. The level sufficient for one year's protection was attained, but rose to very high levels when "stimulating" doses in small amounts were given. The average rise of the titer following "stimulating" doses, after a complete primary and secondary immunization, was found to be 4.3 units per c.cm.

The results show that a longer interval between the primary injections allows a greater antitoxin response initially, but at the end of a year the titers are the same. Three months seems to be the desired interval. It is not known whether a "stimulating" injection is needed when tetanus is suspected.

The results of the active immunity acquired in the combined diphtheria toxoid injections were found to be adequate, although the titers of diphtheria antitoxin lasted for a shorter period than the higher titers of tetanus antitoxin. There is a distinct parallel between the tetanus and the diphtheria with regard to the time of injection and duration of immunity. The combined use of tetanus toxoid does not influence the level of diphtheria antitoxin in human serum. Reactions of toxicity were mild and consisted in burning and stinging at the site of injection, occasional urticaria, and slight fever and malaise.

The authors conclude that combined immunization with tetanus and diphtheria toxoids is practical and possible. The apparent failures in the case of tetanus were no more frequent than those in the case of diphtheria. Due to lack of information at present it is best to give a "stimulating" dose of tetanus toxoid when a suggestive injury occurs.

HENRY P. ROYSTER, M.D.

Beling, C. A.: Treatment of Staphylococcic Infections with Thiazole Derivatives of Sulfanilamide. *Am. J. Surg.*, 1941, 53: 219.

This report concerns observations and conclusions made during the treatment of 130 cases of staphylococcic infections of various types with thiazole derivatives of sulfanilamide. The results in the first 30 patients treated with sulfamethylthiazole indicated that it was a relatively safe drug, and its use was then extended to less severe staphylococcic infections. This drug was withdrawn from use, however, because several cases of peripheral neuritis had been observed by a few investigators. Sulfathiazole was used in all subsequent cases. Fifty-two patients received sulfamethylthiazole and 78 received sulfathiazole.

Staphylococci were identified either from the wounds or the blood stream in all the cases. Seventeen cases exhibited mixed infection with both streptococci and staphylococci, and in 1 instance the bacillus pyocyaneus was present. Following a period of trial it became routine to give an initial dose of 2 gm. and maintenance doses of 1 gm. every four hours to adults. Children received an initial dose of 0.5 gm. per 25 lb. of body weight and maintenance doses of 0.25 gm. per 25 lb. every four hours. It was often necessary to exceed this dose in order to reach and maintain a reasonable level of free drug in the blood. Occasionally adults required larger doses. When it was not advisable to give the drug by mouth, it was introduced through a tube placed into the duodenum. Whenever it was desirable or necessary to obtain an immediate elevated blood level of free drug, sodium sulfathiazole and sodium sulfamethylthiazole were used. From 2 to 3 gm. of sodium salt were used for the average adult of 150 lb., or 75 kgm., and corresponding amounts for children. The frequent use of these compounds intravenously is not justified because of their potential danger to the local blood vessels and to the kidneys. Large numbers of crystals are invariably seen in the urine after injection of the sodium salts into the blood stream. Rectal administration is not advisable since absorption is poor and adequate blood levels are not likely to follow.

For local use a saturated solution of the powder in sterile normal physiological saline solution or in distilled water was used. Irrigation at frequent intervals with a syringe was done or a continuous drip was delivered into the depths of the wound through perforated tubes. The latter method appears to be advisable in extensive compound fractures with macerated tissue and loss of substance. The combination of zinc-peroxide cream with saturated sulfathiazole solution will probably take care of mixed infections involving the staphylococcus and anaerobic streptococci or other organisms.

The thiazoles are excreted much more rapidly than sulfanilamide or sulfapyridine. The drugs should be given every four hours in order to maintain an adequate blood level. This was sometimes difficult in children because of extremely rapid excretion. Variations in absorption were demonstrated in the same individual by daily fluctuations of from 1 to 2 mgm. per cent on regularly maintained and spaced dosage. In the earlier patients who received sulfamethylthiazole it was noted that the average adult exhibited a blood level around 7.0 mgm. per cent of free drug after receiving from 20 to 25 gm. by mouth during the first forty-eight hours prior to the determination. Analysis of later cases showed that an initial dose of 2 gm. followed by 1 gm. every four hours usually results in a blood level of free drug in adults of about 4.0 mgm. per cent and almost always in a level of about 2.9 mgm. per cent. Absorption apparently continued with larger doses as blood levels of free drug exceeding 20 mgm. per cent were obtained. The maintenance of a steady blood level in children was achieved by trial in each individual case. In some children doses of 2 gm. every four hours were necessary to reach and maintain a level of from 4 to 6 mgm. per cent. Recurrences result when the dosage is too low or the drug has been withdrawn too soon. Treatment was continued up to the time of withdrawal so as to maintain a more or less constant blood level of free drug. The free drug in the blood stream diminishes rapidly according to the individual rate of excretion. Pyodermias, carbuncles, infected wounds, cellulitis, and abscesses were treated until the lesion had resolved or disappeared. Febrile conditions such as staphylococcic peritonitis, endometritis, or pneumonia were treated until the temperature, pulse, and respirations had been normal for four days. Acute osteomyelitis and other forms of staphylococcic septicemia require treatment for longer periods in order to prevent recurrences which are almost inevitable with small doses and inadequate treatment time. These cases require a maintained free drug blood level of from 6 to 9 mgm. per cent, until all blood cultures are negative, collections of pus that can be reached have been drained surgically and have healed, and the temperature, pulse, and respirations have been normal for at least two weeks. Treatment should be resumed at the slightest indication of a relapse.

Five patients with acute osteomyelitis have been treated from the inception of the disease. All have recovered. Each had a soft tissue abscess incised and drained and the bone or periosteum was not disturbed. There are now no draining sinuses and there has been replacement of bone in each patient. Although the longest follow-up period is six months after discharge from the hospital and the patient has shown no recurrence or residual disability, sufficient time has not elapsed to allow any conclusions as to the eventual results. Immobilization of the affected part was employed in each case in addition to thiazole therapy.

Urinary infections which are not complicated by mechanical factors such as calculi and certain abnormalities of the genito-urinary tract were treated much in the same manner as carbuncles and febrile conditions. Smaller doses of the thiazoles are sufficient to control staphylococcic urinary infections.

Even though the blood level of free drug is 2 mgm. per cent or lower, the concentration in the urine is high. When other organisms are present, and for complete elimination of the staphylococcus, concentrations of 50 mgm. per cent or higher in the urine are necessary.

Collections of pus must be evacuated and the indications for surgical drainage are unaltered by the fact that a drug is being given. The use of sulfathiazole pre-operatively in adequate amounts, however, is advised for its effect in preventing the spread of infection locally and the development of generalized hematogenous infection. If prompt operation is necessary, the intravenous administration of sodium sulfathiazole will create a proper blood level quickly. The length of time required for any given staphylococcic lesion to respond depends upon its type and the stage of its development. Furuncles and carbuncles will show definite changes within three days and often progress to complete resolution. Certain cases of cellulitis require up to eight days and occasionally longer. The most dramatic and satisfying results in this series were seen in cases with staphylococcic septicemia and with infections of the dangerous area of the face. The reduction of mortality to 27 per cent in the former group is significant when compared with the results from staphylococcus antitoxin and specific bacteriophage. There were 26 cases of facial infection. All of the patients recovered although some had grave and extensive infections.

The blood stream is entirely cleared of the thiazoles, as far as can be detected by routine tests, in from twenty-four to forty-eight hours, the length of time depending upon the amount of drug in the circulation at the time medication is discontinued provided other conditions are normal. Excretion takes place mainly through the kidneys and slightly through the gastro-intestinal tract, so that both forms of the drug are recovered from the urine and feces. Crystals of both may appear in the urine.

All patients were carefully watched for the development of reactions. The frequency of the common toxic manifestations of sulfathiazole were nausea 27 per cent, crystalluria 13 per cent, vomiting 10 per cent, headache 10 per cent, dizziness 8 per cent, skin rash 5 per cent, weakness of extremities 4 per cent, hyperpyrexia 2.5 per cent, hematuria 2.5 per cent, conjunctivitis 2.5 per cent, and diarrhea 1.3 per cent. Sulfathiazole caused fewer side effects of a serious nature and was better tolerated than sulfamethylthiazole. No anemia, leucopenia, renal calculi, cyanosis, or neuritis resulted from sulfathiazole. Sulfamethylthiazole caused 1 case of lower motor-neurone involvement, 2 cases of anemia, 5 cases of cyanosis, and 2 cases of diplopia.

The appearance of reactions to the thiazoles does not seem to be related to the amount of drug given since the most severe reactions were seen with the smaller total dosages.

Patients in this series received total doses of from 4 gm. of sulfamethylthiazole and 8 gm. of sulfathiazole to 244 gm. of sulfamethylthiazole and 295.5 gm. of sulfathiazole, over periods varying from two days to sixty-six days with sulfathiazole and to seventy-five days with sulfamethylthiazole. Most of the patients who took the drugs for longer periods did not have troublesome reactions. Withdrawal of the drug is not indicated in the presence of nausea, occasional vomiting, headache, crystalluria, skin rashes, and conjunctival reactions except under unusual circumstances. These side effects tend to pass within twenty-four to seventy-two hours. Occasionally, vomiting may be persistent or a skin eruption may be especially severe so that medication must be stopped. Whenever there is an adequate urinary output, over 1,000 c.cm. daily, the appearance of large numbers of crystals in the urine should not require modification of dosage. When the output is low, efforts should be made to improve this rather than to withdraw the drug. Moderate anemia has not been considered an indication for withdrawal and in at least 1 case therapy was continued with small transfusions. Microscopic hematuria was also noted but the drug was not discontinued unless the urine was slightly tinged with red or there were increasingly larger numbers of red cells per high power field on microscopic examination.

Absolute indications for the cessation of thiazole therapy, unless modified by further clinical evaluation, are the appearance of gross hematuria, hyperpyrexia, conjunctivitis of severe nature, neuritic symptoms and signs, chills, severe psychic disturbance, and also agranulocytosis, leucopenia, and acute anemia if they should occur. The last three were not encountered in this series.

Of the entire series of 130 staphylococcic infections treated with the thiazoles, 116 showed improvement, 5 did not, and 9 patients died. The criterion for improvement was that the lesion being treated must resolve and disappear within a reasonable time, the length of which depends upon the type of lesion. Four patients died from infection by other organisms after the staphylococcic infection had been successfully eliminated. The remaining deaths were due strictly to staphylococcic disease or staphylococcic septicemia. All but 1 were not seen until very late in the course of the disease and from three to twelve hours before death. The presence of extensive metastatic lesions precluded the hope of recovery. They must be included, however, in order to make any valid comparison with the gross uncorrected mortality in staphylococcic septicemia both untreated and treated by other means.

MANUEL E. LICHTENSTEIN, M.D.

Abraham, E. P., Chain, E., Fletcher, C. M., Gardner, A. D., Heatley, N. G., and Others; Observations on Penicillin. *Lancet*, 1941, 241: 177.

This article presents the observations of a team of individuals at Oxford University who have been studying the biological properties and therapeutic possibilities of penicillin, an anti-bacterial factor in the penicillium originally described by Fleming (*Brit. J. Exp. Path.*, 1939, 10: 226).

The first section describes the growth and methods of production of the penicillin-producing mold. The active penicillin is obtained by extraction of the crude material which is harvested from the culture medium employed for growing the mold. Various methods of assay of the anti-bacterial potency of the extracts are described. The most satisfactory method of assay yet developed involves the measurement of the diameter of the zone of inhibition produced with a standard volume of the material on an agar plate which has been seeded with staphylococcus aureus. One hundred liters of the medium gives a yield of about 1 gm. of therapeutic material, which is approximately the amount required to treat one patient for one day. It has been found that the action of penicillin on bacteria is entirely bacteriostatic in character. In this respect it is similar to the sulfonamides. However, penicillin has the advantage of being uninhibited by pus, peptones, or tissue autolysis.

The strains of organisms which are most suitable to the bacteriostatic action of penicillin include the gonococcus, meningococcus, staphylococcus aureus, streptococcus hemolyticus, bacillus anthracis, clostridium tetani, and clostridium welchii. With all of these types of bacteria, inhibitory effects were observed with dilutions of 1:1,000,000 or less. It was observed, however, that a strain of staphylococcus aureus subjected to increasing concentrations of penicillin finally acquired the capacity for growth in the presence of concentrations of penicillin 30 times as much as that required initially for complete inhibition. The bacteriostatic power of penicillin against streptococci and staphylococci is much greater than that of the sulfonamides, and, unlike the sulfonamides, is only influenced to a minor extent by the number of bacteria to be inhibited. It is believed that the lack of antagonism to the bacteriostatic power of penicillin by breakdown products of tissue autolysis should be of importance in the treatment of suppurating wounds.

Penicillin was found to have little toxic action on leucocytes or cells in tissue culture, being similar in this respect to the sulfonamides. When penicillin is injected subcutaneously or intravenously into mice and rabbits, it is excreted in the urine, but its presence cannot be demonstrated in the blood. However, the intravenous administration of the substance to cats or human beings results in the presence of biologically demonstrable concentrations of penicillin in the blood as well as in the urine. Penicillin is inactivated by the acid contents of the stomach, but if administered through a duodenal tube into the alkaline small intestine, it is absorbed and excreted into the urine in active form. After intravenous injection a large proportion of the active substance can be recovered from the urine and used again.

The difficulties involved in producing penicillin in large quantities have prevented extensive therapeutic trial of the material. The authors report 5 cases of invasive staphylococcic and streptococcic infections in which the intravenous administration of penicillin was employed. It was concluded that in every case in which the supply of penicillin permitted adequate treatment, a favorable therapeutic response was obtained. Cases which had been resistant to various types of sulfonamide therapy were benefited by penicillin. The only toxic effect of any importance was due to a pyrogenic impurity which was not present in the highly purified preparations of the material. Local applications of penicillin in 4 cases of infection of the eye yielded encouraging results.

The authors recognize that many problems remain to be overcome before widespread clinical trial of penicillin can be carried out. However, the encouraging results obtained in a limited experience seemed to justify a continuation of the investigation of this substance. JOHN S. LOCKWOOD, M.D.

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Peterson, H. O., and Baker, A. B.: Difficulties in Differentiating Midbrain Lesions from Cerebellar Lesions. *Am. J. Roentgenol.*, 1941, 46: 37.

The authors describe the roentgenographic and clinical findings in a group of 10 cases in which there was obstruction of the ventricular system in the midbrain or cerebellum. The roentgenograms showed characteristic findings, but it was difficult or impossible to localize the lesions accurately.

In the cases which were studied, the lateral ventricles were dilated, the degree of dilatation depending upon the extent and duration of the obstruction. There was no displacement of the lateral or third ventricle. The third ventricle and the anterior portion of the aqueduct were usually dilated, although in a few instances, possibly because of inadequate filling with gas, this enlargement did not reveal itself in the ventriculograms. The fourth ventricle was also not filled.

The conclusion is reached that an obstruction located in any point posterior to the third ventricle is compatible with these findings and that more accurate localization is probably impossible.

HAROLD C. OCHSNER, M.D.

Renander, A.: The Roentgen Density of the Cystine Calculus; A Roentgenographic and Experimental Study Including a Comparison with More Common Uroliths. *Acta radiol.*, 1941, Supp. 41.

In this exhaustive monograph on cystine calculi the author seeks to establish their roentgen density from the standpoint of physics. Reports in the literature relative to this property have been highly contradictory, and chemical studies to explain possible differences in their absorptive powers have been inconclusive. For the purposes of this investigation all known cases of cystinuria in Sweden in which roentgen examinations had been made were utilized for minute studies from various angles to obtain the desired information.

Cystinuria is discussed in a general way, and a chapter is devoted to a review of the clinical and physical characteristics of cystine and of its occurrence and physiology. The nature and genesis of cystine calculi are also given consideration. Their roentgen density as reported by others is cited at length. This varied with one group of authors from "shadowless" or slight or insignificant density, to "intense shadows" or extreme radiopacity almost equivalent to that of oxalite of lime stones according to others. Experiments conducted by some of these workers are cited and attention is called to some of the fallacies of their conclusions.

The material which forms the basis of this thesis is presented and detailed case reports of the 18 cases studied are included. A special "appendix" to these is devoted to the roentgen appearance and the morphological structure of the calculi in each case. The roentgenograms are reproduced beside the respective photometric curves from the determinations in air, which to some extent illustrate the precision with which it was possible to make the readings in the individual cases. These cases and the calculi found in them are also analyzed from various physical, chemical, and clinical aspects.

Of the 18 cases studied, 15 gave positive shadows on the roentgenogram. The nature of all of these shadows was such as to render them distinctly visible. Chemical examinations of some of the stones showed them to be of a high degree of purity. The 3 cases which failed to show demonstrable shadows are discussed, and it is stated that this failure was due probably to the small size or vacuolated structure of the stones or to concealing intestinal contents.

The evaluation of the roentgen density of the cystine calculus made in this study was based upon the photometric method. Attempts made by others with different methods are cited. The author describes the details of his investigation at considerable length as to choice of method, experimental conditions, results, accuracy of the determinations, and sources of error. The roentgen density of the relatively pure cystine calculi; comparison between the evaluated and the determined roentgen density; the effect of the ash content, structure, thickness; and the use of different wave lengths and of intensifying screens on the determined roentgen densities are all given consideration. Diagrams and tables of the findings are included.

Experimental determination of the roentgen density of other urinary calculi was also undertaken to find out whether the more exact method of photometry would give accurate enough values for the roentgen density of the various urinary concretions to permit of differential diagnosis *in vivo*. Some of the more common typical urinary concretions were selected for this purpose.

In his summary the author lists some of his findings as follows:

The roentgen density of cystine in relation to water for the wave-length region from 0.2 to 0.8 A was calculated according to known laws of absorption and found to vary between 2 and 4.7. The value 3.8 was secured at a wave length which had its maximal intensity with the radiation used in the investigation in air (0.48 A.).

In the photometric examination of the purest cystine calculi in air (ash content 0.3 per cent), an average value of 3.8 was obtained at 50 kv.

The roentgen density of the cystine calculus increases with the ash content; a good determination in air on a stone with an ash content of 13 per cent gave the value 4.6.

The small calculi, of which the structure was often loose and vacuolated, showed a relatively lower roentgen density than the larger ones. This circumstance further complicated the roentgenographic demonstration of the small cystine concretions.

The roentgen density of the cystine calculus decreased somewhat with the wave length and dropped in air from 3.8 at 50 kv. to 3.2 at 90 kv.

No systematic variation in roentgen density depending on the thickness of the cystine stone could be found.

The same value was obtained for the roentgen density of the cystine calculi both when intensifying screens were used and when they were not.

Determination of the roentgen density of the cystine calculus in water, with the use of a secondary diaphragm and intensifying screens and in general under the same conditions as those which apply in a roentgen examination in practice, gave an average of 2.7, or 30 per cent lower than in air.

No real variation in the roentgen density of the cystine calculi in water could be observed at the voltages used in practice (from 50 to 64 kv.).

The roentgen density of the cystine calculus in water increased with the ash content, as is the case in air, and amounted to an average of 3.4 in a stone with an ash content of 13 per cent.

Photometric examinations of other urinary concretions showed a roentgen density in air of 1.1 for the uric-acid stone, 4.9 for the calcium-oxalate stone, 5.1 for an ammonium-magnesium-phosphate stone, and 7.6 for the calcium-diphosphate stone, all in relation to water.

A roentgen density in water of 3.2 was obtained for the ammonium-magnesium-phosphate stone, and of 5.7 for the calcium-diphosphate stone.

The only values for roentgen density of any direct importance in practical roentgenography are the ones determined in water under the same conditions as in ordinary clinical roentgenographic examinations.

A calculation of the contrast of the concretions in relation to the soft parts showed an exponential increase of the contrast with a function of the absorption coefficient and the thickness of the stone.

There seems to be reason to believe that the photometric method may come to be of practical use in the differential diagnosis of urinary concretions.

ADOLPH HARTUNG, M.D.

Leucutia, T., Witwer, E. R., and Belanger, G.: Late Results in Benign Giant-Cell Tumor of Bone Obtained by Radiation Therapy. *Radiology*, 1941, 37: 1.

This article is based on a study of 33 cases of giant-cell tumor of bone treated from 1923 to 1935, inclusive. All cases are tabularly arranged, special attention being paid to the dosage of the radiation therapy. Fifteen cases are illustrated with roentgenograms made before and at intervals of from five to fifteen years after the treatment. In the beginning an association of curettage and postoperative irradiation was used with the result that 30 per cent of the cases had to have amputation later, either because of secondary infection or lack of filling in of the bony cavity. Since 1930 radiation therapy is used exclusively. Even biopsy is taken only in rare instances when a diagnosis cannot be established otherwise. In 18 cases so treated, a good local result was the rule and all patients completely regained the normal function of the affected bone. In the entire series malignant transformation occurred once, in a case treated by repeated curettements and postoperative irradiation. Two patients died from incidental causes, one seven years and the other one year after treatment.

As a whole, the impression is gained that radiation therapy is preferable to surgery, since it does not lead to infection, since a filling-in of the tumor-destroyed bone area occurs more completely, since malignant degeneration is obviated, and since, above all, irradiation is a simple method and, with the proper technique, entirely harmless to the normal structures. In case of failure, surgery always can be applied later without untoward complications.

The technique of irradiation is as follows: deep roentgen therapy with 200 kv. equiv. (1 mm. of copper forefilter) may be used although supervoltage roentgen therapy with voltages above 200 kv. equiv. saves the skin and the normal structures to somewhat better advantage. The initial dose represents 70 per cent SUD and is reduced at the rate of 10 per cent SUD per series subsequently. In the authors' instances, 100 per cent SUD is equal to 900 roentgens on the skin or tumor (525 roentgens in the air) when the irradiation is done in one seance over a 20 by 20 cm. field at 20 r/min. intensity, and the quality of the roentgen rays is that obtained with 200 kv. equiv., 1–1.5 mm. of copper and 1.0 mm. of aluminum. For higher voltages it is increasingly more. The full series is given in one day, several fields being used for the purpose of crossfiring of the tumor area. The treatment is repeated within two months and at gradually spaced intervals thereafter, often for a period of as long as two years, until complete reossification has occurred. The ossifying capacity of the bone varies, among other things, with location and age. Some very remarkable results have been obtained in children with considerably smaller doses.

The management of the patient during this prolonged course of irradiation is important. In the earlier days, especially when curettement with the creation of large hollow cavities preceded radiation therapy, complete immobilization with plaster-of-Paris casts was applied routinely. However, it was noted that the marked demineralization from disuse tended to retard greatly the process of reossification. Therefore, the patient now is permitted rather free use of the affected limb, precautions against a pathological fracture being taken only in connection with weight-bearing functions. If a pathological fracture has already occurred, this is treated according to standard procedures, but the period of immobilization is made as short as possible to prevent too much demineralization.

Arons, I.: Further Studies on Radiotherapy of Lymphoblastoma. *Radiology*, 1941, 37: 164.

The author gives a rather extensive survey of 42 articles collected from the literature dealing with various pathological, clinical, and radiotherapeutic phases of lymphoblastoma. His own material includes 45 cases, 12 of which were Hodgkin's disease, 15 lymphosarcoma, 13 leucemia, and 5 borderline cases between leucemia and lymphosarcoma.

The fact is emphasized that often considerable difficulty is encountered in reaching a definite diagnosis and that frequently the course of the disease and its reaction to radiotherapy furnish the only criteria upon which a differentiation may be based. Even so, the boundaries between the three aforementioned varieties of lymphoblastoma are often very closely drawn.

The choice of treatment is practically limited to roentgen and radium therapy, with the former predominating. Eight cases are briefly described to illustrate the good immediate response to radiation therapy. In 1 case, that of Hodgkin's disease, the good result lasted for over seven years.

It is now apparent that in lymphosarcoma, Hodgkin's disease, and leucemia the involved areas are more numerous and larger than surmised clinically. It is not sufficient, therefore, to irradiate only the confirmed areas, but suspicious lesions should be similarly treated. The author himself prefers irradiation with the fractional-dose methods since he believes that in addition to destruction of the local lesions, protection of the reticulo-endothelial system with a view to preventing generalization of malignancy is important. Therefore he recommends that the optimal total dose should be the smallest one possible and that the fractions should be repeated at sufficiently brief intervals to insure the above desiderata.

This treatment, though palliative, may treble the life expectancy of the patient. T. LEUCUTIA, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Skinner, H. L.: Dupuytren's Contracture. *Surgery*, 1941, 10: 313.

The present treatment of Dupuytren's contracture consists of complete excision of the contracted fascia. If the viability of the skin is in doubt, it is excised and the defect is filled with a free, full-thickness graft. In selected cases full-thickness, tunnel skin grafts have been used to fill in the defect. The operation is performed under gas anesthesia, with a blood-pressure cuff as a tourniquet. An incision is made along the ulnar surface of the hand curved slightly inward at its proximal end. This exposes the narrow upper end of the fascia which is isolated, clamped, and cut. The fascia can then be lifted upward and away from the palm by gentle traction on the forceps, and the numerous fasciculi may be divided as they pass in different directions. The separation of the skin from the fascia, especially at the point of the nodules and pitlike depressions, is rather difficult. The dissection is carried distally until all contracted fascia has been removed. If the contracted fascia extends into the phalanges, separate incision and dissection may be necessary. This must be done with care in order not to injure the digital nerves and vessels. This dissection, along with freeing of the skin, is the most difficult part of the operation.

After controlling all hemorrhage, the skin is obtained for the tunnel graft. Two or three grafts are put in place transversely under the skin according to the requirements of the case. The grafts are placed under the areas of devitalized skin, the size of the latter determining the width of the graft. The source of the graft is unimportant except that due consideration should be given to the location as to texture and hairlessness. The skin of the area from which the graft is to be taken is prepared the day before operation. The graft of necessary size is outlined on the skin, then carefully and gently dissected free with a sharp knife as fat free as possible. Small puncture wounds are made at necessary points, one on each side of the incision.

The tunnel graft with the raw surface downward is pulled through the puncture wound on one side of the incision and is allowed to extend beyond the incision on the other side. The wound is then sutured snugly with fine silk and without drainage. It is not necessary to suture the ends of the grafts in place. Five or six layers of vaseline gauze are placed over the palm of the hand before the dressing is applied. The dressing is held in place with a tight bandage. The forearm and hand are splinted with the finger in extension. The bandage is tightened on the fourth or fifth day and is not removed until the tenth or fourteenth day. At this time, under local anesthesia, the skin is cut over the grafts and a portion removed if necessary. Usually, however, the edges are allowed to retract or atrophy. A 20 per cent argyrol dressing is applied for a few days and is followed by whirlpool baths, massage of the fingers, and exercise. At this stage cod-liver-oil ointment is a satisfactory dressing with splinting of the fingers in extension at night.

The use of this type of graft in this affection offers several advantages. This type of graft has been used for various other conditions and its growth has been more universally successful than any other in the author's experience. The vitality of the graft seems greater. It is completely surrounded by living tissue which furnishes an ideal environment, and if it is necessary at any time to change the dressing, the latter will not disturb the graft. In the placement of the graft, close apposition is assured, movement does not occur, and accurate fitting and cutting are unnecessary. The maintenance of proper tension is no problem and mild infection does not affect the graft. The graft is capable of adjusting itself to a movable contour of the underlying parts. The whole procedure is quicker, less tedious, not uncomfortable to the patient, and gives the surgeon less anxiety.

MANUEL E. LICHTENSTEIN, M.D.

Crosbie, W. E., and Wright, H. D.: Diphtheria Bacilli in Floor Dust. Strains Found; Contamination of Air from Floor Dust; Disinfection of Floor Dust. *Lancet*, 1941, 240: 656.

The danger of cross-infection via dust and bedclothes is emphasized and the number of organisms thus dispersed has been enumerated by bacterial counts in the hospital. The technique consists of collecting the floor sweepings in glass tubes, suspending them in broth, and culturing the liquid on Hoyle's medium. After twenty-four hours' incubation the colonies of gravis, intermedius, and mitis varieties were distinguished. Airborne organisms were collected by allowing plates to stand 3 feet from the floor for a period of five minutes. The virulence in certain cases was established by guinea-pig inoculation. Only a few mitis strains were non-virulent.

Forty-four samples of dust were examined, and diphtheria bacilli were found in 37. The prevalence of the bacilli is more marked in rooms where diphtheria cases are treated, although they are also found in other parts of the hospital. The bacilli in naturally contaminated dust have been found to remain viable as long as one hundred and two days. They were found to persist on an oiled fumigated floor for one month. The air was found to be heavily contaminated, particularly during sweeping and bedmaking, but the bacilli were greatly reduced after the floor was oiled. The source of this air contamination was thought to be the bedclothes, since the plates showed numerous organisms during bedmaking, while the floor yielded very few after treatment with 1:40 phenol solution and oil.

The passage of bacilli from floor to throat was suggested when a positive culture was obtained from the outer part of a mask worn by a nurse. Two patients with previously negative throat cultures gave positive cultures after being in a contaminated room for several days. The combination of scrubbing (with an antiseptic) was more effective than oiling alone on the number of organisms in the air and on the floor. The defective technique of fumigation is deplored and the authors strongly advise the employment of antiseptic scrubbing and oiling, particularly of the floors. A highly antiseptic oil would be ideal, but as yet none has been found to be effective.

The importance of droplet infection has been noted in the past, but now it is evident that the floor and the milieu around the patient himself are potent sources for the spread of pathogenic organisms. The source of air infection itself is still a moot point, and this work supplies evidence that the floor and bedclothes are possible factors in the spread of diphtheria bacilli. HENRY P. ROYSTER, M.D.

Broders, A. C.: The Microscopic Grading of Cancer. *Surg. Clin. North Am.*, 1941, 21: 947.

The difference in malignancy of the same type of carcinoma in different situations often is explained by a difference in blood and lymph supply. This explanation is inadequate. The high average of malignancy of squamous-cell carcinoma of the tonsil, nasopharynx, posterior half of the tongue, esophagus, vagina, and uterine cervix, as compared to the lower average of malignancy of the same type of carcinoma of the anterior half of the tongue, buccal surface of the cheeks, lips, skin, penis, and labia, most certainly cannot be explained on the basis of a difference in blood and lymph supply. Neither will this explain the difference between the high average malignancy of adenocarcinoma of the breast and stomach on the one hand, and the lower average malignancy of adenocarcinoma of the large intestine and body of the uterus on the other hand, nor the high average malignancy of melanotic carcinoma of the skin, and the lower average malignancy of basal-cell carcinoma of the same tissue.

The microscopic grading of cancer was based on the fundamental principle of cell differentiation and is absolutely independent of the clinical history. The cancers are divided into four grades according to the following principles:

Grade 1. A Grade 1 epithelioma is one in which about three-fourths of the cells are differentiated and one-fourth are undifferentiated; it would be better to say that a Grade 1 epithelioma is one in which differentiation, or self-control, ranges from almost 100 per cent to 75 per cent, and undifferentiation from almost nothing to 25 per cent.

Grade 2. A Grade 2 epithelioma is one in which differentiation, or self-control, ranges from 75 per cent to 50 per cent, and undifferentiation from 25 per cent to 50 per cent.

Grade 3. A Grade 3 epithelioma is one in which differentiation, or self-control, ranges from 50 per cent to 25 per cent, and undifferentiation from 50 per cent to 75 per cent.

Grade 4. A Grade 4 epithelioma is one in which differentiation, or self-control, ranges from 25 per cent to practically nothing, and undifferentiation from 75 per cent to practically 100 per cent.

In the prognosis of malignant tumors in general, it probably is not necessary to say that well informed physicians take into consideration a number of factors; however, I do not hesitate to state that the numerical grade of malignancy is by far the most important one.

GENERAL BACTERIAL, PROTOZOAN, AND PARASITIC INFECTIONS

Provenzano, R. W., Carriel, G. E., and Bloomer, A.: Anthrax. *New England J. Med.*, 1941, 225: 332.

In spite of the fact that effective treatment is available, the general mortality from anthrax shows no tendency to decline. It continues to be a serious industrial hazard. The authors present the case of a forty-year-old man who was admitted to St. Joseph's Hospital, Lowell, Massachusetts, with an anthrax lesion on the left forearm which followed scratching with a burr while handling wool nine days before admission. At the time of admission, smear and culture from the pustule showed staphylococci, so the patient was put to bed and sulfathiazole was administered. Blood cultures revealed anthrax bacilli, as did the second set of smears and cultures from the vesicles, so anthrax serum was administered at once, both intravenously and locally. A total of 850 c.cm. of serum was given in eighteen hours, followed by 300 c.cm. in the next thirty-two hours. Twenty-four hours after the beginning of the administration of serum, cultures and smears were reported negative for anthrax bacilli. Sulfathiazole was continued for another seven days. The patient made an uneventful recovery. The authors state that the serum therapy was started after fourteen days of illness, and the combined sulfathiazole and anti-anthrax serum therapy produced negative smears and cultures in twenty-four hours. They suggest a possible synergistic action of sulfathiazole and serum. MARIAN BARNES, M.D.

DUCTLESS GLANDS

Van Nieuwenhuizen, C. L. C.: Disturbances in the Resorption of Carbohydrates, Fats, and Vitamins in Hypophyseal Insufficiency (Resorptionsstoerungen der Kohlenhydrate, Fette, und Vitamine bei hypophysaerer Insuffizienz). *Acta med. Scand.*, 1941, 108: 195.

Although many physiological studies dealing with the significance of the hypophysis in the resorption of foodstuffs have been published, the author was unable to find reports in the literature of clinical observations of disturbances in resorption related to hypophyseal abnormalities. The present study was further stimulated by a desire to clarify the etiological relationship of the cachexia commonly encountered in cases of hypophyseal tumor, as well as to

elucidate, as far as possible, the influence of disturbances in the hypophyseal-diencephalic system upon the occurrence of endemic "sprue."

A careful review of the literature is presented. The author then outlines his own method of study and experimentation to determine the effects of abnormalities of the hypophyseal-diencephalic mechanism in the development of deficiency states and cachexia. The experimental technique employed was as follows:

1. Hematological examination which consisted of hemoglobin determination, measure of the average size of the erythrocytes with the Piper apparatus, and the red and white cell count.

2. Determination, by the fractional method, of the free and total gastric acidity after ingestion of a test meal consisting of oatmeal gruel.

3. Sugar tolerance determination by the method of Hagedorn and Jensen.

4. Fat tolerance test according to Rueckert's method.

5. Vitamin A tolerance determination by study of the Vitamin A content serum in the fasting state, and four, six, and ten hours after the administration of 40,000 units *per os* (technique of Wolff, Emmerie, and van Eckelen). In normal individuals and experimental animals an increase ranging between 100 and 500 per cent in Vitamin A content was found about four hours after the administration of the test dose.

6. Vitamin B_1 tolerance test, which was done according to the method of Jansen and his coworkers.

7. Vitamin C tolerance curve determined by the method of Wolff, Emmerie, and van Eckelen.

The results obtained from these investigations on the normal subject are soon to be published. The author reports several clinical cases in great detail. In 1 patient with acromegaly severe disturbances of the resorption of Vitamins A and B_1, as well as of fats and carbohydrates, were noted. The clinical picture was in large measure similar to that of endemic sprue. The diarrhea in this case was due to nicotinic-acid deficiency. The resorption of fats and carbohydrates was definitely improved, and that of Vitamin B_1 apparently improved by the administration of desoxycorticosterone. This leads to the belief that disturbances in resorption of these substances is, at least in part, due to an adrenal insufficiency. Similar findings were observed in a case of diabetes insipidus.

The observations of the author lead one to conclude that at least a part of the manifestations of hypophyseal cachexia are due to disturbances in resorption. The question of the part played by abnormalities of the hypophyseal-diencephalic system in the causation of endemic sprue is also discussed.

HARRY A. SALZMANN, M.D.

Richter, C. P.: The Sodium Chloride and Dextrose Appetite of Untreated and Treated Adrenalectomized Rats. *Endocrinology*, 1941, 29: 115.

Previous experiments by the author had shown that adrenalectomized rats developed an increased appetite for sodium salt, thereby keeping themselves alive. In the present experiments a comparison of the effect of desoxycorticosterone acetate in oil, adrenocortex extract, and charcoal adsorbate of adrenocortical hormone was made by observing the effects on the salt appetite and carbohydrate intake in adrenalectomized rats when these substances were administered.

An operative method for removing the adrenal glands is described in detail. This method is advantageous in that total removal of the adrenal tissue is assured.

Invariably after adrenalectomy, the sodium-chloride intake increases markedly, and the dextrose appetite decreases. It is probable that the decreased appetite for dextrose indicates an inability to absorb carbohydrate rather than an inability to utilize it.

As measured by the rats' appetite, desoxycorticosterone acetate affects both the sodium-chloride and carbohydrate balances, but it tends to return the sodium-chloride intake to a more normal level than that of the carbohydrate intake. Cortical extract improves both the salt and carbohydrate metabolism, but the effect is less pronounced on the former than on the latter, in contrast to the effect of desoxycorticosterone acetate. The charcoal adsorbate likewise had a greater effect in improving the sodium-chloride metabolism than in improving the dextrose metabolism.

From the experiments, the author concludes that the three products used were roughly equivalent with regard to potency in the following amounts: desoxycorticosterone acetate 0.5 mgm., cortical extract 2 ccm., and charcoal adsorbate 6.8 gm.

The water intake increased markedly after adrenalectomy, but decreased sharply with the administration of any of the three drugs used.

LUTHER H. WOLFF, M.D.

SURGICAL PATHOLOGY AND DIAGNOSIS

Valls, J., Ottolenghi, C. E., and Schajowicz, F.: Aspiration Biopsy for the Diagnosis of Lesions of the Vertebral Bodies (La biopsia por aspiración en el diagnóstico de las lesiones de los cuerpos vertebrales). *Bol. y trab. Acad. argent. de cirug.*, 1941, 25: 743.

The authors state that with their technique it is possible to perform without any risk an aspiration puncture of the vertebral bodies of certain segments of the spine. They recommend the use of external puncture for the bodies of the fourth to seventh cervical, and of the eleventh dorsal to fifth lumbar vertebræ. The pharyngeal route is preferable for the first three cervical vertebræ, and experiments on cadavers have shown the inadvisability of trying puncture for the first ten dorsal vertebræ.

For puncture of the bodies of the last two dorsal and the five lumbar vertebræ, the authors use two needles and a guiding instrument. One needle, 18 cm. long and 1 mm. thick, is the exploratory needle and serves as mandrel for the aspiratory needle, which is from 12 to 14 cm. long and presents at 6

cm. from its tip, markings 1 cm. apart, to show how far the needle has penetrated into the tissues. The guiding instrument consists of a metallic ruler divided into centimeters and provided with a slider which carries a small point to fix the instrument on the median line. One extremity of the ruler presents a canal, 2.5 cm. long and placed at an angle of 125 degrees, through which will pass the two needles; a simple arrangement allows disconnection of the guiding instrument from the needle once the latter is in correct position. The patient is placed in ventral decubitus on a roentgen table: roentgen examination is indispensable to obtain the exact position of the needle.

An anesthetic wheal is first made in the median line over the spinal process of the involved vertebra with a ½ or 1 per cent novocaine solution; then the point is marked at which the needle must be introduced; this point is located 6.5 cm. from the median line and preferably on the left side in order to avoid the inferior vena cava; the same anesthetic solution is used for superficial and deep infiltration of the tissues at this point, and the skin is pierced with a tenotome. The guiding instrument is installed by pushing the point of the slider into the anesthetized skin on the median line and the two needles, one inside of the other, are introduced into the canal of the ruler which will give them the necessary inclination to reach the vertebral body at a depth of from 6 to 7 cm. from the skin. The fine needle, attached to a syringe to allow aspiration during introduction, is first used to pierce the soft tissues, and when it has come in contact with the vertebral body, frontal and lateral roentgenograms are taken to verify the correctness of its position. The large needle is then pushed into contact with the vertebral body and the thin needle and the guiding instrument are removed. The large needle is then easily passed into the softened vertebral body to obtain material by aspiration; if any difficulty is experienced in penetrating the vertebral body, the needle is manipulated without losing contact with the bone until a softer part is found.

For puncture of the bodies of the four last cervical vertebræ, the lateral route is used and the sternocleidomastoid muscle serves as guide. The patient is placed in lateral decubitus, the posterior border of the muscle is located, a vertical line is run down the neck from the posterior border of the mastoid, a dermal wheal is made with the anesthetic solution behind this line and at the level of the involved vertebra, and deep infiltration of the soft tissues is performed. The skin is pierced with a tenotome and the two needles, one inside of the other and the thin one mounted on a syringe to allow aspiration during its introduction, are inserted in a slightly forward direction; the vertebral body is reached by the thin needle about 3.5 cm. from the skin. Frontal and lateral roentgenograms are then taken to verify the position of the needle, the large needle is pushed into contact with the bone, the thin needle is withdrawn, and the aspiration of material is performed as usual.

The authors have used the diagnostic puncture successfully in 19 cases of lesion of the spine and describe several cases to demonstrate the great value of the method. RICHARD KEMEL, M.D.